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SCIENCE
AND
CHRISTIAN THOUGHT.



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BY

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"Unto the Son he saith, Thou, Lord, in the beginning hast laid the foundation of the earth; and the heavens are the works of Thine hands."—*Heb. i. 10.*

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PREFACE.

THIS work is an inquiry into the present relations of science to Christian thought. At no former period has the subject assumed aspects of deeper interest than now. The last twenty, and especially the last ten, years have been marked by great progress in the chief branches of natural science. A wide field has been surveyed, and a great number of facts have been brought to light, bearing, more or less closely, on revealed truth. Much new and fresh material has been accumulated, of great value to all who "take pleasure in seeking out the works of the Lord," and who love to trace in Nature the goings of Him who is great in his Church, as a God of righteousness, grace, and love. An effort is here made to bring some of this material within the reach of all, and to render it popularly interesting. In doing so, the Author holds himself alone responsible for the accuracy of the statements made and the scientific facts referred to.

This increase of knowledge, the fruit of success-

fully advancing science, has come to be an occasion of difficulty to many. Thoughtful men have seen, with regret, several distinguished students of science, not content to discover and expound facts, becoming hastily anxious to present them in forms opposed to the plain teaching of the word of God. In these circumstances it may be profitable, and not uninteresting, to look at the whole question both from the purely scientific and from the Christian point of view. Any statement, however popular and attractive, which is not the fruit of practical familiarity with the departments of natural science under discussion, will not satisfy that numerous class of earnest men who wish, above all things, to find the truth.

CONTENTS.

CHAPTER I.

INDIRECT ADVANTAGES OF SCIENTIFIC STUDY.

	PAGE
Influence of the study of natural science on Christian thought— Attitude to revealed truth—Importance of minute characteristics—Things essential and non-essential—Scripture history— The lesson of humility—Illustrations: the rose, sundews, diving spider, female glow-worm, goat-sucker—Sternum of birds—Quotation from Hooker—The lesson of labour—Man's limited powers—Influence of Christian thought on scientific pursuits—Fanciful interpretations	1

CHAPTER II.

SCIENCE AND CHRISTIAN THOUGHT.

The two records—Christ the Creator—The Holy Spirit's teaching and human learning—Scripture writers, their knowledge of nature—Science and illustration of Scripture—Instance from geology—Instance from anatomy—Meteorology—Chemistry—Natural science and natural theology—Influence of Christian education on students of science—Points of harmony between Scripture and science—Illustrations: mode of study, stability of nature, natural history of man, geologic history of the earth—Light shed on Ephes. iii. 8-11, and Coloss. i. 16-18—Miracles—Testimony of geology to miraculous working—Interferences with course of nature—Mooted points—Retrograde movement—Attempt to stop controversy—Quotation from Augustine	15
---	----

CHAPTER III.

CHRIST IN HIS OWN WORKS.

	PAGE
Remark by Paley—Infidel objection—Discovery slow—Illustrations—Sources of knowledge—"Known unto God are all his works"—All things by Christ—Sovereign control of second causes—Dr. Chalmers on argument for being of God—Distinctions between properties of matter and forces of matter—Illustrations from the coal measures and from the nature and relations of elementary substances—Interest of this field—Forms of simple substances—Law of definite proportions—"My Father worketh hitherto"	38

CHAPTER IV.

ARGUMENT FROM DESIGN.

"God created all things by Jesus Christ"—Special adaptations—Correlations of structure—Cuvier's law—Bridgewater-treatise point of view—Structural differences between carnivorous and ruminating animals—Quotation from Aristotle—Evidences of progress—Photography—Objection to argument from special adaptations—"Consider the lilies"—Presence of a personal God in nature—Illustrations of Gen. ii. 7; Eccles. iii. 20, etc.—Man and the earth—Man's dependence on elements in oldest rocks—The animal and the vegetable—Wheaten flour—Discoveries of MM. Dumas and Bousingault—Adaptations	57
---	----

CHAPTER V.

THEORY OF LATENT VITALITY IN MATTER.

Refusal to acknowledge the testimony of special adaptations—Old scientific heresies—Origin, growth, and energies of living forms—Creative energy—Vital phenomena—Phenomena of intellect and will—Quotation from Dante—Review of argument for
--

latent vitality—Its unscientific character—Scripture view—The student of science not entitled to ignore the testimony of Scripture—Sir Charles Lyell—Mr. Darwin—Vague theories—Recent objections not original—Ancient physicists—Quotation from Jeremy Taylor—Spermatic virtue—Illustration of Psalm xix.—Biblical references to light—Spectrum analysis—Remarkable results—Darkness—Illustration of Isa. xlv. 7; Job xxxviii. 19, 20; Matt. vi. 23; and Luke xi. 23	75
--	----

CHAPTER VI.

GENERAL ADAPTATIONS.

Illustrations from the earth's surface—Influence of these on man's moral nature—Evidences of intention—Moral bearings—Power and phenomena—Personal will in nature—Contour of continents and progress of inhabitants—Relations between them—Illustrations—Coast-line and commerce—Atlantic and Pacific Oceans—The earth made for man—Development theory; mistakes—True point of view—Progress in creation—Hugh Miller's view of development defective—Complication of structure and zoological rank—Importance of geological study to Christians—Natural law—Knowledge of Adam's immediate descendants—Physical features of original seat of human race, and of Palestine	111
--	-----

CHAPTER VII.

GENERAL ADAPTATIONS CONTINUED.

The ocean—Constituents of sea-water—Quotation from Professor Forchhammer—Oceanic equilibrium—Moral influences—Eccles. i. 7—Oxygenation of the waters—Quotation from Guyot—Biblical references to the sea	141
--	-----

CHAPTER VIII.

ATMOSPHERIC ADAPTATIONS.

PAGE

Ancient speculations—Chemical constituents of the atmosphere— Mechanical combination—Natural formation of nitric acid—Its limitation—Control of personal will over natural law—Hegel— Quotation from Dr. Temple—Interference with continuous working of law—Illustrations—Sovereignty of Creator—Evi- dences of—Principle of gaseous diffusion—Biblical references to the atmosphere—Special illustrations of Jonah iv. 6-8 . . .	156
---	-----

CHAPTER IX.

GENESIS AND SCIENCE.

Changes in the attitude of science to Christian thought—Genesis i. and ii.—Scientific speculations—Interest of to intelligent men —Historical character of opening chapters of Genesis— Schemes of reconciliation between Genesis and science—Scheme of Dr. Chalmers—Scheme of Cuvier—Views of Hugh Miller— Geological classification of Edward Forbes—Laurentian rocks —M. d'Orbigny's arrangement—Review of Genesis i.—Un- satisfactory character of Hugh Miller's age-theory—Principal Dawson's views—A better scheme of interpretation and re- conciliation—"Created and made"—"In the beginning"— Genesis i. not to be associated with geologic time—Importance of this view	176
--	-----

CHAPTER X.

MAN'S PLACE IN NATURE.

Four aspects of the antiquity of man—"After their kind"— Origin of species; Biblical chronology—Appeal to the Bible —Speculations of M. de Maillet—Lamarck—Remark of Fontenelle—"Vestiges of Natural History of Creation"— Darwin's "Origin of Species"—Huxley's "Man's Place in
--

Nature"—Baden Powell's "Essay on the Philosophy of Creation"—Zoological features of man's place in nature—Carl Vogt's "Lectures on Man"—Drift of Huxley's work—Embryonic peculiarities—Materialistic character of Vogt's work—Man and the apes—Views of M. Gratiolet—Influence of recent views on national morality—Hypothesis—Plurality of original simial stocks—Macacus and chimpanzee—Gibbon and orang—Mandrill and gorilla	204
---	-----

CHAPTER XI.

THE ANTIQUITY OF MAN.

Traces of man in ancient superficial deposits—Danish kitchen-refuse-heaps, or kjökken-möddings—Quotation from Sir Charles Lyell—Alleged antiquity of refuse-heaps—Extinct forms—Great auk—Lake or pile dwellings—Geologic aspects of the question—Cuvier's theory of the earth—Contemporaneity of man and the great extinct mammals—Review of facts bearing on the subject—Ox, deer, elephant, rhinoceros, hippopotamus, Irish deer, bear, hyæna, cat—Quotation from Dr. Falconer	223
---	-----

CHAPTER XII.

ANTIQUITY OF MAN CONTINUED.

Superficial deposits—Peat—Stone, bronze, and iron periods of the antiquary—Danish peat zones—American peat—Scottish peat—False conclusions—Dr. Dowler's calculations—Cypress swamps of the Mississippi—Peat of the Outer Hebrides—Mud deposits—Mr. Horner on Nile mud—Plains of Bengal—Dr. Buist on the formation of Lower Bengal—The loess—Cave-men—Discoveries of Dr. Schmerling—Liège caverns—Engis skull—Valley of the Neanderthal—The Neanderthal skull—Professors Huxley and King's views of this skull—M. Lartet on the cave-men of Aurignac—Gravels of the
--

Somme valley—Mr. Prestwich's views—Excavation of valleys	
—Influence of ice—Oscillations of level—Quotation from Sir	
Roderick Murchison—Morlot on the study of high antiquity—	
True science corroborates the Biblical account of the recent	
appearance of man	241

CHAPTER XIII.

THE UNITY AND BROTHERHOOD OF THE HUMAN RACE.

Quotation from Sir William Hamilton—Man's twofold nature—	
Eccles. iii. 18-20—Christ's kingdom and man's—Views of	
modern materialists on man's nature—Instinct and reason—	
Human brotherhood—Interactions between science and Scripture	
—Man's place unique—Views of systematists and ethnologists	
—Two schools—Place of the negro—Missionary effort—Christ	
"Lord of All"	285



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from Hooker—The lesson of labour—Man's limited powers—
Influence of Christian thought on scientific pursuits—Fanciful
interpretations.

It is proposed in this chapter to indicate, in a very general way, and as introductory to the discussions which follow, some points at which Science meets Christian thought, and sheds over it influences of a kind highly conducive to intellectual humility, and even to moral health.

And here, first, the reflex influence of scientific studies on our attitude toward revealed truth is worthy of notice. That demand for liberty of judging as to what is inspired and what is not, as to what we may receive and what reject of Scripture statement, and that assertion of inherent spiritual capacity of true choice, which Priestley, first, in this country set forth so powerfully both in popular and in, so called, philosophic points

of view, have had influences far beyond the sect to which he belonged. We can scarcely open a book which deals with the testimony of the Bible to the ways and works of God, or with the vital question of inspiration, without meeting with these. Men are unwilling to take the Word as a whole, and to reserve judgment until they have truthfully examined its claims to infallibility. They follow the bent of individual likings, and hasten to rash and unfair conclusions on isolated parts. To this tendency may, in part, be traced that disposition, at present so often met with, to subordinate the doctrinal statements of Scripture to its moral precepts. The former, it is said, are only human speculations, the latter must be received and obeyed as necessary both to peace in this world and good hope for the world to come. But to what does this tend? Man becomes to himself the fountain of truth. As the spider finds the material for its net in itself, so man finds his ground of confidence. His taste, his prevailing habits, the breath of circumstances, the passing whim, his social relations, are all permitted to influence him in determining what is true and what is false.

Now, one of the earliest impressions made on the student in biological investigations, is, that there can be no true knowledge of any one form of life, if our examination has been confined to individual parts of structure. We wander from the true track, and are sure to land in error, when we imagine, either that the minutiae of structure are not of equal value with the great points, or that acquaintance with the leading features supersedes all necessity of becoming acquainted with those which lie farther out of sight. We first

learn the lesson of trust, by taking the form as having a right to the place traditionally assigned to it by science; and then we study it under the feeling that we must know it as a whole, by the examination of all its parts, before we can attempt to remove it from this place. Indeed, in the deeply interesting study of the relations between different forms of life, success almost always depends on the power to appreciate minute and often, apparently, very remote characteristics of individual parts.

The indirect influence of the habit here implied is most valuable. We come imperceptibly to see the danger of trusting to our own views as to the value of this or that feature, unless we have regarded it both in the light of the whole organism and also in that of closely related forms of life. To have rejected one part because it seemed to us unimportant, or perhaps not even necessary to the whole, would have been to misinterpret nature, and to miss the discovery of the thoughts of the Creator. The rudimentary teeth in the jaw of the foetal whale might seem useless and superfluous, when we look to the habits of the full-grown animal; but how suggestive these are, when we regard them in the light of unity of creative plan in certain great groups of animals! What to superficial thinkers may often seem trivial, unimportant, almost unworthy of the great and eternal God, is often of highest value.

In nature, in providence, in grace, illustrations are abundant. What important events, running through all church history, turned on the removal of a few shepherds from Shechem to Dothan,* on the walk of a king's daughter by the Nile,† or on the wandering of

* Gen. xxxvii.

† Exod. ii.

a few mules from their owner's fields !* The Supreme Ruler works thus still. What a history followed the unusually severe frost which marred the Russian campaign of the first Napoleon !

Again, much is said, in the midst of present inquiry, about things essential and non-essential in the Word of God. We are ready either to deny the justice of this distinction and to suspect as lax all who hold it, or to be so influenced by it as, virtually, to make it the occasion for rejecting everything which we do not like. But there is a better way—a way by which the distinction may be recognised as valuable, while we yet abate nothing from the weight of the things themselves. This we may learn from nature. Take, for example, the bone (the *sternum*) which forms the true framework of the body of any closely-related families of birds, or even of genera, belonging to the same family, or the structure and form of the teeth in any two closely-related groups of mammalia. In the former case, as among the thrushes, for instance, there are several remarkable modifications. Then, were we to predicate similarity of structure from the character of the food, in parts not directly associated with digestion, we should be far misled. In the grain-feeding peacock, the part just referred to is marked by two outstanding lateral processes ; in the grain-feeding pigeon by one only. In the latter case we might compare the teeth of the insect-feeders with those which subsist on vegetables. The teeth of the latter would have been as effective for crushing insects as the former, yet what well-marked differences characterise them ? As far as present knowledge goes, we must fall back on other

* 1 Sam. ix.

ground than telcology, and appeal to other kinds of analogy than are generally dealt with. All we know of these forms warrants the inference that such peculiarities are not essential to the life and preservation of the animals. In a word, we are entitled to speak of them as non-essential. But they claim our regard because they exist by divine appointment. More light may show us uses connected with them of which present science never dreamed. Thus, with much of Holy Scripture. Historical events are recorded, family arrangements described, trifling incidents have prominent places assigned to them, genealogical lists are preserved, and ceremonial practices spoken of, whose bearings on God's great plan of self-manifestation, as a God of grace and righteousness, we cannot at present see; but, as in nature, they, too, are here by Divine appointment. This fact strikes at once a blow at the root of a habit which soon leads all who yield to it to take, in the long run, the very ground of those who make their opinions the standard of truth.

Then, how much this variety in non-essentials illustrates another feature of the Word! What diversity of gifts, of individual peculiarities and dispositions, of tastes even, God has made use of in revealing to us his mind! The end casts its light back on the means. We see the reason as we study. In every part what freshness, what variety, what constantly-recurring novelty, what ever-changing interest, associated with oneness of purpose, end, and aim! If we open our eyes on nature we see the same God working. The leaves of every species of plant perform the same functions, and are destined to the same ends; but what wondrous variety!—variety again, not, as we think,

essential, unless we are raised to sympathy with the Creator, and discover in beauty the highest usefulness. The leaves of different species of trees differ, but this is only half of the truth. It would puzzle the closest observer to find any two leaves on any one branch exactly alike.

Once more. "The kingdom of men found in science," says Bacon, "is like the kingdom of God. It can be entered only in the character of a little child." Every right-minded successful observer will, sooner or later, be taught this lesson in the study of nature, as in the study of the Word. Even in common and long familiar phenomena we are shut up to it when we look at them closely and fairly. What was mysterious to one age may, indeed, become plain to another ; but it is soon seen that the result, in most cases, has been to associate even the well-known with yet other aspects of uncertainty. Have we fully explained why the calyx of the *rose* is green, and the corolla red, or white, or variegated, by being able to trace it to the presence of chlorophyll in the sepals, or by saying that colour depends on the nature of the surface on which light falls? While watching one of the sundews (*Dionæa muscipula*), we notice that so soon as an insect touches a certain part of its unfolded leaf-lobes, the leaf suddenly closes on it and kills it. Do we know all about this when we trace it to the great irritability of a few hair-like spines on each leaf? Is there not much more to be known? Are there flesh feeders among vegetables as among animals? Is the decay of the animal matter, under the influence of the atmosphere, necessary to supply nourishment to the plant? Or, is this no more than an effort of nature to preserve her balance by interposing checks

against insect increase, in the same way as the instinct of certain animals hurry them to destroy vermin which they will not eat?

We take into account the various mental processes and correct knowledge of natural laws implied in the invention of the pneumatic-trough and the diving-bell; but the tiny *Argyroneta* had applied the principles of the former, ages before its invention, and before Priestley and Scheele had used it in the greatest discovery of modern chemistry—the isolation of oxygen as an elementary body. Guided by Him, whose constant and unerring in-working we call instinct, this insect weaves for itself a waterproof dwelling, and fastens it to the vegetation at the bottom of the water. The water which fills it when fastened in its place, must be expelled. In order to this, the owner of the house entangles air-bubbles on the surface of the stream by a process of great simplicity and beauty, and, with these adhering to the small hairs which cover it, finds its way to its nest, sets them free in it, expels a corresponding volume of water, and repeats the process till sufficient space for a habitation is filled with air. We are well acquainted with the facts, but have we solved all the difficulties associated with seeming acts of volition, and even complicated processes of reasoning, by merely saying that every diving spider does the like thing?

The female glow-worm—a flat, grey-brown wingless beetle—alone possesses the electric light and brilliancy for which it is noted. Is the reason of this limitation to the female, and its use, explained by affirming that the light is given to enable the winged male to know where she lurks? But there are other

insects similarly constituted which are destitute of this luminosity.

Or, to take our illustration from higher forms, it used to be thought that we had accounted for the serrated, or pectinately incised middle toe of the goat-sucker (*Caprimulgus*), by assigning to it the duty of cleaning the bristles which thickly beset this bird's mouth. But a comparison of the bristles with the serrature, shows that they are too thick for the incisions—they could not enter them. Besides, the closely-related genus, *Podargus*, which resembles our goat-sucker in its habits, has no serrated claw, while other birds, destitute of the bristles, have.

In some birds, again, at certain seasons, such a change takes place in the plumage for a few weeks as to make them appear different species. Have we explained this by tracing it to the power of love at the breeding season? A pretty thought, no doubt; but then other closely-related birds, having the same instincts, undergo no such change.

Once more, the bony framework in birds, to which reference has already been made, is in some species marked by two small oval holes, covered by a thin membrane; in others, and especially in almost all, if not in all, used as food by man, these bone-enclosed holes give place to deep indentations—sinuses which give rise to well-marked lateral processes—united by a very thin transparent membrane also. With nothing in bird-anatomy are we more familiar. But can we explain the final cause? Much, very much, remains to be known, even in those things with which we are most familiar. At every increase of knowledge the day seems breaking into perfect brightness; but the next

step shows that when the light was brightest we were on the threshold of the dark.

οὐδε τα πάντα

Εκ Θεου ανθρωποι γινωσκομεν αλλ' ετι πολλα
Κεκρυπται.

But this fact is not a bar to research. On the contrary, it is an incitement thereto. And as we search and ponder, wait and watch, in the spirit of learners, we enter lovingly into the sentiments so tersely and admirably expressed by Hooker:—"When I behold with my eyes some small seed or grain whereof nature maketh a promise that a tree shall come, and when afterwards of the tree any skilful artificer undertaketh to frame some exquisite and curious work, I look for the event; I move no question about performance either of the one or of the other. Shall I simply credit nature in things natural? Shall I in things artificial rely myself on art, never offering to make doubt; and, in that which is above both art and nature, refuse to believe the author of both except he acquaint me with his ways, and lay the secrets of his skill before me; when God himself doth speak those things, which either for height and sublimity of matter, or else for secrecy of performance, we are not able to reach unto? As we may be ignorant without danger, so it can be no disgrace to confess that we are ignorant."

But if we are to get deeper insight into the ways of God, and bring to light many evidences of Divine wisdom which still lie hidden, even in common things, success must be won by work. The lesson is not one of lowliness only, but one of labour chiefly; such knowledge never, like the manna in the olden time, drops down from heaven. It is with this, as with earth's

treasures, they lie far out of sight. Nature has to be conquered before she will tell us all her secrets, or yield into our bosom her riches. Toil of brain, work of hands, and sweat of brow must unite in action before the silver and the gold, the iron and the coal can be pressed into man's service, or any of those "stores of fire" be reached, which Marlowe has so graphically strung together:—

"Fiery opals, sapphires, amethysts,
Jacinths, hard topaz, grass-green emeralds,
Beauteous rubies, sparkling diamonds,
And sold seen costly stones of so great price,
As one of them, indifferently rated,
Might serve in peril of calamity
To ransom great kings from captivity."

Nor is the lesson of the limited nature of man's power less distinctly taught than the spirit in which he should seek scientific knowledge. Illustrations in abundance are at hand. For example, in chemical analysis the only limit recognised is that reached when compound bodies are resolved into elementary substances. But if, in organic chemistry, we try the opposite process—try to bring back the elements into their former place, condition, and form—in a word, try to build up the organism, on the very threshold we are made to feel the impossibility. The child may take down the most complicated mechanism. There his power ceases. So in nature. Nor is the state of mind resulting from this of little value. As to create is God's prerogative, so he alone knows the heart and can reveal the future. In actual life, at present, this state of mind will find room for exercise; for, even though unwilling to waste precious time in detecting the tricks of pretenders to a knowledge of, and control over, the unseen world and

the heart of man, we are quite safe in turning away from them. Such knowledge and power belong to God alone.

But are the habits of thought now insisted on favourable to the acquirement of secular knowledge?—Are we not asked to carry into the study of science impressions which will ever lead us to see external nature under, so to speak, a theological atmosphere, and to deal with the facts of science from the theological point of view? Will this be helpful to impartiality? Such questions have been often put, and even good men have given currency to the assertion, that while men of science can deal with theological questions without bias and partiality, theologians are not able to study science in the same spirit. Of necessity, it is alleged, they must be men of one-sided views, and, as students, sadly wanting in depth and comprehensiveness. Just as if there were something in revealed truth when systematised, calculated to dwarf the understanding and to narrow the intellect. Now, it is acknowledged in the outset, that we wish to carry our personal love to the Saviour, and what attainments we have made in biblical knowledge, into the following discussions, claiming credit for an impartiality which we are convinced can only be found in such an attitude. Yea more, we wish to lift the facts and discoveries of science up to the higher platform of religious truth, and to present them for service to Him whose are “the earth and the fulness thereof.”

Indeed, it would be difficult to believe that any man can shake himself free from moral tastes, and confine himself simply to bare, naked phenomena in the study of nature. Men are not angels; yet, the nearer we come

to their point of view, the truer will be our interpretation, because they see all things in the light of their Lord's glory. It is, however, an intellectual impossibility to limit attention to isolated facts. We are impelled by the very laws of our mental constitution to put this and that together ; in a word, to seek the interpretation of facts; and the man of science who stands, personally, nearest the Creator is sure to form the justest estimate of his works. Some of the post-Cuvierian French naturalists, and one or two of the present English advanced school, have protested against the conclusions of teleology, and boldly denied that plan, purpose, creative forethought, can be legitimately said to have determined the forms of animals, their relation to external nature, and the like. The triumph of these views would be the death of discovery. Had such a belief been held by the great masters of science—by Cuvier or by Owen, for example—comparative anatomy would have been yet only in its infancy, and those grand generalizations of geology, touching the climatal condition of the earth and the relations between this and its inhabitants in pre-Adamic epochs, would not have been heard of.

It is unhappily too true that there have been unwise men in science as in theology—men whose fancy has far outrun facts, and who, in looking into nature, have put light imaginings in the place of scientific inductions—men who have told us that nature is no more than a system of symbols, that no phenomena are understood unless seen to have direct moral lessons, and who find all the moral qualities of man to have been first realised in the lower animals. No wonder that inquirers who mistook this for the science of theology should have dreaded the theological spirit. But all

this has been equalled by interpreters of the Word who have told us that the account of creation in Genesis has no reference to the external world, but only to its archetype in the Divine mind, condescendingly named by them "the seat of the incorporeal essences of the natural elements"—that the man made in the image of God was not the progenitor of our race, but "the ideal exemplar of God"—that the mist from the ground was, as a symbol of intellect, the prophecy of the true historical Adam, and the herb of the field, as typical of sense, the prophecy of the coming One.

This sort of thing—mist borrowed from a very early age—has influenced not metaphysics only, but biblical interpretation, if not pulpit ministrations. But darkness is not depth. Haze is not an infallible mark of genius. Now there is no better safeguard against this, no better cure for its fascination over young and often inferior minds, than those patient investigations to which all are called who give themselves to the study of any branch of Natural Science. Nor are actual attainments in science absolutely necessary in order to this. An intelligent interest in the progress of science, and the power to appreciate its facts, tend in the same direction. These re-act in a highly profitable way on man's mind as a student of the Bible. As he reads, the oft-recurring question is not "How does this expression or that harmonise with my preconceived views of the character and ways of God?" It is rather—"What special truth is taught me here, if I am as faithful in interpreting the words of the living God as I am when seeking to ascertain the meaning of words used by my neighbour?" The value for, and constant appeal to facts—to well-understood phenomena—characteristic of

true science, shed a most healthy influence on our habits of thought. They tend, moreover, to foster at least an intellectual readiness to hearken to the exhortation, "Search the scriptures," *ἑρευνᾶτε τὰς γραφὰς*, an expression which indicates an attitude to truth better illustrated in earnest scientific study than in aught else. Its import is, track the truth as the hound does the game, by the foot scent.

CHAPTER II.

SCIENCE AND CHRISTIAN THOUGHT.

The two records—Christ the Creator—The Holy Spirit's teaching and human learning—Scripture writers, their knowledge of nature—Science and illustration of Scripture—Instance from geology—Instance from anatomy—Meteorology—Chemistry—Natural science and natural theology—Influence of Christian education on students of science—Points of harmony between Scripture and science—Illustrations: mode of study, stability of nature, natural history of man, geologic history of the earth—Light shed on Ephes. iii. 8-11, and Coloss. i. 16-18—Miracles—Testimony of geology to miraculous working—Interferences with course of nature—Mooted points—Retrograde movement—Attempt to stop controversy—Quotation from Augustine.

“THERE are two books,” says Sir Thomas Browne, quaintly, “from which I collect my divinity; besides that written one of God, another of his servant nature—that universal and public manuscript which lies expanded unto the eyes of all.” The words are interesting; not, however, so much because they give great prominence to a view of nature too seldom seen, as that they very clearly point out a chief source of error, to many who have earnestly sought after God in his works. The message which he sends to man by “his servant nature” must never be allowed to overshadow, or to weaken that which is contained in his holy word. Indeed it may, in a sense, be said that the former never assumes its highest bearings to any but to those who, in the disposition of little children, have welcomed the

latter as the word of a Father. It has not unfrequently happened that able students, who have begun to work under the impression that the revelation of God in nature is in all respects of equal value and importance with that contained in his word, have soon wholly turned aside from love to the Scriptures. Nevertheless the revelation is one, but it is presented to us in two distinct and broadly defined aspects. Both claim our attention. The one as characterised by countless evidences of the manifold wisdom, goodness, and love of the Creator; the other as unfolding the unsearchable riches of the grace of the Redeemer. Taken together, they make known to man all that God wishes him to know of his person, works, and ways. They have far too often been regarded as in some sort antagonistic. A theology not pervaded by the mind of Christ has frequently pointed to the eager, painstaking, earnest, and loving study of nature, as scarcely compatible with a childlike trust in the blessed promises of the written word.

It is a ground of thankfulness that this state of matters is rapidly passing away. Advancing science meets everywhere a revived Christianity, and both profit by the contact. Science takes Christianity by the hand and leads her into regions everywhere radiant with evidences of the presence of her living Lord. Christianity stands by Science at those innumerable points where she meets phenomena which she cannot explain, and teaches her the lesson of simple faith where she cannot understand. Indeed the two must meet. How important, then, that they should do so as humble handmaidens of the same exalted Lord! Every step in science suggests topics which have direct religious bearings; and

Scripture holds out the Creator's welcome to all who long for those deeper insights into the ways of God, which lie not near the surface of any of his works ;

"The works of the Lord are great,
Sought out of all them that have pleasure therein."

But the invitation to search into nature is not to be regarded as only a preparation for controversy. The study of science assumes aspects far more interesting than those which are merely polemical. "It is not," as the late Archbishop Whately has so well said, "for the refutation of objectors merely, and for the conviction of doubters, that it is worth while to study the two volumes—that of nature and that of revelation, which Providence has opened before us—but because it is both profitable and gratifying to a well-constituted mind to trace in each of them the evident handwriting of Him, the Divine Author of both." It will be found, that it is only as we acknowledge this higher and more important view, that we shall be able to wield with skill the weapons which science puts into our hands in defence of revealed truth. In this we find the qualification not only for standing on the threshold of the temple of Truth to thrust back intruders, but to enter in, kindly to take the gainsayers with us by the hand, and to show them a sight fitted to disarm the bitterest enemy, and to turn deadly hatred into love;—even this, that those works with which science deals, and into which she bends her steady gaze, were all made by Him who laid down his own life for us on Calvary. The Saviour himself was the creator of all things. The Holy Spirit testifies that he is "Lord of All." Now, what is implied here? Not kingship over

redeemed souls only. King he is ; but he is much more. Of the world of life and loveliness, of brightness and beauty, which lies around us, he is the creator and head. How little is made of this aspect of the glory of the eternal Son, even by the church which he has redeemed by his own precious blood, and which should ever stand near to him, and ever readily enter into the Father's thoughts concerning him ! But great prominence is given in the Bible to this view of the glory of Christ. " God, who at sundry times, and in divers manners, spake in time past unto the fathers by the prophets, hath in these last days spoken unto us by his Son, whom he hath appointed heir of all things, by whom also he made the worlds." Thus the Father's words to him were not only, " Thou art my Son, this day have I begotten thee," but also, " Thy throne, O God, is for ever and ever," " And thou, Lord, in the beginning hast laid the foundation of the earth, and the heavens are the work of thy hands." (Heb. i.) Thus it was that " when on earth all things served him, from the greatest to the least, even to the fishes that walked through the paths of the sea. He was the Lord over all nature."

This being true, we might have anticipated that men who stood so near to Christ in sympathy and aim, as did the inspired writers of Scripture, would make much of the phenomena of that world of matter over which he is creator and head. Such was the case. Indeed it was in this as it was in regard to their other attainments. We cannot have studied the Bible with much intelligent care, if we have failed to discover how ready the Holy Spirit has ever been to accept the treasures of human learning, when brought to the altar of God by

humble worshippers, and how cordially he has ever owned and blessed their use in the service of the sanctuary. This indeed is true of all human attainments. It was true of the learning of Egypt carried into the work of God by Moses; of the political sagacity and remarkable administrative abilities of Daniel; and of the profound scholarship, dialectic skill, and vigorous intellect of Paul. But, perhaps, it was specially true of the knowledge of nature, both in its obvious features and in many even of its most remote processes, possessed by the writers of Scripture—knowledge acquired by the servants of God after much laborious, painstaking investigation and unwearied observation. The more deeply we have studied the Word in the light of favourite pursuits, the more we must have been struck with this.

If we take any book of the Bible—the writings of Moses, of Solomon, of Isaiah, of Joel, or of Amos, for example—what do we find? In almost every verse there are allusions to the outward world, to outstanding phenomena, general features, and special adaptations. Indeed, these form the garb in which, as in a royal robe, many of the grandest and most precious of God's great thoughts of grace are presented to man. In almost every case they bear testimony to a carefulness of observation, a close watching of natural processes, *and a fine power of appreciating the precise points at which the phenomena may be associated with the thoughts without degrading the thoughts*, which we might advantageously imitate more lovingly than we have ever done.

Again, science has recently rendered most valuable service to religion by setting many long familiar passages of Scripture before us in new, peculiarly fresh,

and often striking aspects. Take, for example, the expression, "foundations of the world." You have the words, "The Lord layeth the foundations of the earth." This was his special work. Accordingly he asks one of the greatest of his servants—"Where wast thou when I laid the foundations of the earth?" He could not answer. He must be dumb. But one, in whose heart he even then was, revealed in after ages what might have been the answer on His behalf in the depths of the eternal counsels—"When he appointed the foundations of the earth, then I was by him, as one brought up with him, and my delights were with the sons of men" (Prov. viii. 29-31). This was he "who verily was fore-ordained"—as substitute and surety—"before the foundation of the world." The same who, in the hearing of a little company, knit to him by love, said to the Father, "Thou lovedst me before the foundation of the world." Job's Redeemer answered the challenge, that sovereignty in nature might be seen subordinated to sovereignty in grace; for in all this we had a standing: "He hath chosen us in him before the foundation of the world, that we should be holy and without blame before him in love." Now, why this reference? Is it not to impress the disciple with the thought of the eternity of the Father's covenant love? Yes! But see how he is to be led into this. Reason is carried back to a point in the world's age, at which, if it would go farther, it must borrow the wings of faith. And this is done in a way fitted to influence the whole spiritual nature of man. In olden times saints were met by the assurance that four or five thousand years before their day God had loved them, in order that they might wonder as the mind went back to the very edge of the uncreated, and

that they might be fitted to listen intelligently when told of love to them even before that—"I have loved thee with an everlasting love." The force of the appeal being, "Go back in imagination over those thousands of years that lie between your day and Eden. During all these I have loved you." But how this thought has been intensified, this lesson deepened by geological discovery. We are not now led over 6,000 years only, but are called to a survey of world on world; a series of creations each one of which implies the lapse of ages, compared with which the time between this day and Eden comprises a period relatively little greater than that which passes while we read a few pages. Yet all through those great ages, all through the mighty upheavings which marked the beginning and close of epochs, and all through the immense periods of their continuance under divinely given and divinely guided natural laws, the Father loved us; we were "chosen by him in Christ before the foundation of the world."

Or take another well-remembered word: "I will praise thee; for I am fearfully and wonderfully made" (Psalm cxxxix. 14). Try and enter into the Psalmist's thoughts here. Regard "*substance*" in the context, as used in the Psalm to indicate, as I think we are warranted to do, "strength," the framework of bones and muscles. Then realise the twofold meaning implied in the phrase "curiously wrought;" namely, something interwoven and *beautified in the act*. Then look at these expressions in the light of present attainments in human anatomy; and have we not now more cause for the intelligent cry than at any other time we could have had—"Marvellous are thy works, and that my soul knoweth right well"?

Again, in how many new and unexpected lights has recent meteorology set the key verse of Psalm xxxvi. "Thy mercy, O Lord, is in the heavens ; and thy faithfulness reacheth unto the clouds" ? Has not chemistry given new interest to that numerous class of passages in which the varied phenomena of evaporation, of dew, of cold and heat are referred to ? It has even seemed as if, at one point and another, were about to travel beyond what has hitherto been held to be its allotted sphere, namely—to deal with matter, with substance only—and to shed remarkable illustrations on the great mystery of the resurrection of the body itself. These facts are mentioned at this point, not because they are the only ones, or even the most striking, but because they come first to mind. Many more illustrations of the benefits conferred by science on revelation will occur in the sequel.

We come now to consider the relation of natural science to natural theology. Here we see its chief value. In approaching this subject let us note (1) The striking change which in the space of a few years has taken place in the attitude of science to revelation, while we indicate certain symptoms of reaction from present attainments ; (2) The leading questions in regard to which controversy is still waged. We shall then, more in detail, review the present state of the question of unity of plan in creation—of adaptations between means and ends : in a word, the doctrine of final causes.

It is a valuable testimony to the influence of Christian education in the community, and over many of the ablest thinkers of the day, that one of the first questions

sure to arise the moment discoveries in natural science are announced, is one touching their bearing on revealed truth. Are they in harmony therewith? Or do they even seem antagonistic? So alive to this have some of the foremost naturalists become, that they are ever forward to urge, directly or indirectly, that this or that, in new discoveries, does not conflict with Scripture statement. This state of mind has been most favourable to the growth of knowledge—to the progress of science. A very general approach has been made to standing-ground as helpful to science as it is safe for Christian thought. This, no doubt, is, in part, to be traced to more frequent and freer intercourse between theologians and men of science; but even more to the circumstance that a greater number of the former than used to be the case, have come to occupy leading places in fields of investigation, which before were left to the avowed sceptic, and the open enemies of revealed truth. Each class, moreover, has come to see how much it owes to the other. The student of science feels that he is indebted to enlightened and accomplished Christian men, in preparing the popular mind for receiving his discoveries, in smoothing down the opposition of good but often not very well-informed men, and in welcoming every new fact, as opening up fresh views of the works and ways of God. The Christian again sees how much help science has brought to him in his efforts to improve general education, to further the social and industrial good of the people, to present the truths of the unchanging Word in many-sided and fresh aspects, and to let in new and before unlooked-for light upon the testimony of Scripture to the majesty, greatness, omnipotence, wisdom, and eternal beauty of Jehovah.

"Thine, this universal frame
Thus wondrous fair; thyself how wondrous then!"

May this accord not only continue, but embrace many more topics than it has yet done!

Let us briefly indicate some of the points at which this accord may be seen.

First as to modes of study. Few men will now protest against the application of even a sifting process of historical criticism to the chronological and historical facts of the Word of God. Science says, Try my claims; look my facts in the face, this is all I ask. The Word by its very presence, as an open Bible, seems to say, "Deal thus with my claims to inspiration and Divine authority. The more these are examined the brighter will be the testimony." Science speaks with the same tongue. Receive none of its pretensions until you are satisfied by close research that they are made for good reasons and based on good ground. Thus they are at one as to the mode of study.

Again, in scientific investigations, everywhere the action of forces are met with which seem to bear testimony to the stability of nature. These are generalised under the name of natural law. In this form they used to be isolated from everything like a controlling will, and were accounted sufficient to explain both the existence and continuance of the phenomena in which they are met with. It is now seen that the Bible speaks in many places as strongly of this stability of nature as science has done, and is as ready to acknowledge the action of these forces. But in order that science may be blessed and set in the highest of all relations, the Scriptures show, that He of whom the scientific student has caught a glimpse, as of one passing by in ill-defined, mysterious grandeur, as the sovereign controller of

natural forces, is none other than the Everlasting Father the portion of his people he, who gives his bosom to his children to rest on when they are weary.

But this harmony presents itself in yet broader and more interesting bearings, well deserving recognition. And first, as to the natural history of man himself. At almost every point of inquiry into this history, based on correct principles, remarkable corroborations of the Scripture account of man have occurred. Science equally with Holy Writ regards him as the last created form of animal life, it acknowledges his headship over nature, it accords to him his rightful place as the interpreter of the works of his Creator, and, in the estimate of most, it asserts and defends the great doctrine of the unity of the human race, on which, both by direct statement and inferentially, the Bible so earnestly insists. But on every side there are symptoms of reaction. Influential parties have come to question each of these topics. Farther on we will deal with the grounds of the reaction, and point out how firm the true foundations still are.

Then, second, as science has advanced and thrown its influence over the highest Christian thought of the nation, how much fresh light has been shed on the geologic history of the earth itself in its relation to the bringing in of man. We have not been looking for science in the Bible. Let us never seek to make it responsible for what it was never designed to teach. But if, while following recognised principles of interpretation, and not wayward fancy, we find God waiting, as it were, to accept our highest point of view, and from this standing-ground to show us that he had, not indeed anticipated our discoveries, but been before us in the knowledge of his own plan, both in itself and in the

manner of its working out, let us not refuse to walk farther into the light. We shall have occasion to point to a numerous class of Scripture passages with the illustration and exposition of which we have not hitherto associated the teachings of science, but, it is earnestly hoped, the reader will not imagine, that in doing this, even a tendency exists to make more of science than there is warrant for.

The drift of these remarks will be apparent if we take the following as an example :—“ Unto me, who am less than the least of all saints, is this grace given, that I should preach among the Gentiles the unsearchable riches of Christ; and to make all men see what is the fellowship of the mystery, which from the beginning of the world—*ἀπὸ τῶν αἰώνων*—hath been hid in God, who created all things by Jesus Christ; to the intent that now unto the principalities and powers in heavenly places might be known, by the church, the manifold wisdom of God, according to the eternal purpose—*κατὰ πρόθεσιν τῶν αἰώνων*—which he purposed in Christ Jesus our Lord ” (Ephes. iii. 8-11). Compare this with Col. i. 16-18, “ For by him (God’s dear Son) were all things created, that are in heaven, and that are in earth, visible and invisible, whether they be thrones, or dominions, or principalities, or powers : all things were created by him, and for him : and he is before all things, and by him all things consist. And he is the head of the body, the church.” Now we need not here deal with the exegetical questions which these verses give rise to, or even with their references to power, linked with a heart of infinite and everlasting love and a mind of infinite wisdom. But the references to

the divine purpose of the Creator, and to the design of creative energy, raised by such an expression as "all things were created *for* him"—εἰς αὐτὸν—to subserve the purpose he had in view, namely, the manifestation of his own glory, and the glory of the Father in connexion with his own headship over the church, warrant us to turn aside and inquire, if there be anything in the words of geologic science, to show that, even then, he had been ever working upwards to this grand end. And here again the hints of Scripture come out as broad statements of truth, when science adds her testimony to these. Our own epoch not only overtops geologic ones: it could not have been without them. From the very foundation rocks themselves, as we shall have occasion to point out, up to the soil which nourished the vegetation of Eden, this finds its illustration. In the elements stored in non-fossiliferous rocks, in the remains of organisms which later were introduced, we may read not prophecies only of man's appearing, but evidences of Divine preparation for this. Yea, without following fancy or leaving the track of sober science, we can appeal to countless phenomena, broadly indicative of arrangements which had in view the spiritual history of man himself—of one who was to be disciplined, by contact with trial, with work, with weariness, for a sphere into which none of these can ever enter. And if so, how can we refuse to take another step, and acknowledge the intimate relation between creation and redemption—between the arrangements even of geologic times, and the suitableness of the present material earth to receive Him and to give Him a body, "by whom we have received the Atonement"? It is true then, not only that all the things of our epoch

were created for Christ, but all things of all the epochs were so.

But, third, the great question of miracles has come in for a share of the benefits of this better understanding between theologians and students of science. The time has not long gone by, when a very general feeling existed on the part of both, that there was not the least likelihood of any approach to harmony between them. Suspicion hung, like a hound, on the track of discovery, or brooded over it like a dreary mist on a lovely landscape. A strong impression prevailed, that the prominence constantly given, in scientific investigations, to the action of natural law, the forwardness of students of nature to trace all phenomena no higher, and their evident love to dwell on it, as having been working in remotest geologic epochs much in the same way which it does now, were nothing more than covert efforts to undermine the foundations of revelation, and to bring thought back to the darkness and helpless negations of the Democritic point of view—the point of new atheism. But unexpected discoveries were made by onlooking Christian apologists. They were agreeably surprised to see, in the very suspected quarters themselves, a thousand witnesses arise to speak to the truthfulness of their own cherished beliefs. Natural law was indeed not equal to explain all phenomena. The presence of a Divine person was acknowledged, shedding his glory forward from primeval times. The darkness was parting, and a light, like that of the Shekinah, was seen bursting forth and gradually widening the gloomy portals through which it was to burst. In one word, the workers in the fields of science were publishing the evidences of miraculous interference, with what had been known as

immutable natural law, as wonderful as any to which the theologian had pointed, and in defence of which he had buckled on his armour. This opening up of new fields of illustration—new and fresh aspects of the subordination of law to the will of a personal God, and new proofs of personal interference with what had been named “the ever and evenly-working forces of creation,”—could not but smooth down opposition, beget an altered mien to science, and lead to a better understanding between all parties in search of truth.

Nor is it uninteresting or unsuggestive to note, that all this has come about in consequence of those very views regarding the history of the earth, which, early in the present century, so greatly alarmed the church. Instead of now finding cause for fear in the claims then urged for an immense period of duration before Adamic time, we find in this view of the earth’s age some of the most valuable evidences of miraculous action, and some of the most striking proofs of the working of that very hand which, later, touched the dead and brought them to life again. We have now only to set out from the right point of view—a point of view to which we are shut up if only honest in truth-seeking—that, namely, of the being of God, and of belief in nature’s testimony to his eternal power and Godhead. And this the Bible itself accredits even to the Gentiles. Starting thus, our investigations will soon shut us up to the acknowledgment of numerous evidences of direct interference with the material earth itself. These breaks are not as if a link in the chain had given way. Though this might almost be granted and our ground continue strong; for what hand but that of the supreme God could have interclasped me links

again? They are rather the results of the divine, intelligent Worker's interference. He had halted in adding link to link. He had broken the even succession of the ages of nature, and thus had given proof that the Creator is above, and can control, all nature. But here we have not the highest proof. Here we have chiefly the evidence of the sovereign working of the will of an Omnipotent One. The miracle is most apparent in creating, in giving life. And this is very fully shown by the introduction of new species, the bringing in of living forms which had no place in creation before. In this we have proof of miraculous action as remarkable as that seen in the chamber at Shunem, or at the tomb in Bethany, or by the gate of Nain, or in the desert track on the eastern shore of blue Galilee. "It is a truth," says Agassiz, "which I consider now as proved, that the *ensemble* of organised beings was renewed not only in the intervals of each of the great geological divisions which we have agreed to term formations, but also at the deposition of each particular member of all formations." "As far," says Professor Le Comte, another able and accomplished observer, "as the evidence of geology extends, each species was introduced by the direct, miraculous interference of a personal intelligence." "There has," he adds, "indeed been a constantly increasing series; but the connexion between the terms of the series has not been physical or genetic, but intellectual; not founded on the laws of reproduction, but in the eternal counsels of the Almighty." This, no doubt, strikes the point of interest. The introduction of even one new species testifies both to creative forethought, and to the putting forth of power above nature.

Thus far then the analogy from geology. The inference is irresistible. If, in realising his great world-plan, miracles are seen to stand out as proofs of eternal power and Godhead, is there not, to say the least, a very strong presumption, that we might expect, from the same quarter, similar proofs of the authority of that great revelation in which his righteousness and grace are made known to man? And, if we narrow the question, and fix our attention on man, the inference becomes even more weighty and well defined. Not only are we sure that there have been periods marked by great luxuriance of vegetation and numerous forms belonging to the highest groups of mammalia, during which man had no existence, but also that his appearing is of a comparatively recent date.

On this point, as we have seen, the testimony of science and revelation is one. His creation was the fruit of a miracle even more wonderful than the creation of matter itself. The very language employed by the Holy Spirit, when preparing for this, seems to point to the power, authority, and dignity of God's noblest, yet now vilest, creature. But gather up the testimony of science to the adjustments even of natural conditions necessary in order to man's very existence, and you will see how strong the evidence of the presence of a wonder-working One is, and how irresistible the conclusion that man's existence is the fruit of direct miraculous power.

This question of adjustment is itself of highest interest. Unreflecting persons, having traced man's coming to the Divine purpose and the exercise of an Omnipotent will, see no further than the fact of his creation. They do not see how that fact influenced all nature; they do not see how thoroughly it must have altered ten thousand things the moment it was realised; they do not see that

only the putting forth of a wisdom and power, equal to creative, could have prevented all things hastening to inextricable confusion when such a new creature was introduced.

Man's relations to the earth and to all in it were to be of the most intimate, complicated, and often most subtile kind. The soil needed to be fitted for a vegetation unlike any that had previously been ; the dependence of the vegetation on a condition of atmosphere of a very peculiar kind had to be determined, and man's own relations to other forms of life to be fixed. It was, indeed, impossible for him to be ushered into being without a place having been provided for him, which implied direct interference with every other form of life, and the readjustment of conditions of the most varied kind. But who could grasp the difficulties implied? Who could grapple with them but the Almighty, who is above his own workmanship, and can do all things according to his own sovereign will? Again, then, the inference is irresistible :—if we have proof of all this as to man's creation, what wonder that, at a higher point in his history, we should see the hand of the wonder-working One stretched forth for the highest of moral ends, man's advancement to fellowship with his heavenly Father?

If we refuse to look at these things, to weigh them, to be influenced by them, it must only be because we love to continue ignorant. If they do not teach us the lesson that miraculous working has all along characterized the dealings of God with creation, and with his creature man, it must be because we cast the shadows of prejudice on what is true, and fail to see the fair face of truth through the darkness. The influence

of such considerations has come to be felt by all workers in science, and a far better understanding than hitherto, now prevails between them and those whose chief study has been the word of God. So thoroughly indeed is this the case, that the departure from this point of view, which at present is becoming so strongly marked, pays remarkable homage to the prevailing state of feeling, but in doing so increases the danger. The working of miraculous power is acknowledged, and then the force of the testimony is destroyed, by making it no more than the action of a law higher than is commonly called natural—a law lying so far out of sight that we get only a glimpse occasionally of its continued action—a law which stands, in some measure, in the same relation to that with which we are acquainted, as does that under which the vast elliptical journey of some of the comets is performed to the revolutions of the planets within our system. They would thus make the law the same, and only extend the intervals between its apparent action, or would hold it no more than the action of forces belonging to “a world whose phenomena are only half revealed to us.”

I come now to some of the mooted questions. They are merely mentioned here, and will be more fully handled afterwards. Notwithstanding these approaches to agreement on many most important points now referred to, there are not a few signs of a great change in a wrong direction—in a direction avowedly hostile to revealed truth. This retrograde movement was begun and is persevered in by a very influential class of observers—men deservedly noted for great scientific attainments. This is worthy of notice, were it on no other account than the contrast it presents to the attitude of the

church to science itself. We are persuaded there never was a time at which the leading and influential thinkers, belonging to all divisions of the Christian church, stood in more friendly relations to science than they now do. This is not only highly to their credit, it should also be a rebuke to those who have assumed a very different attitude to the Bible. The leaders of the retrograde movement claim for science a power for which she has never been, and never will be, equal—even to explain the origin of both organic and inorganic forms, and to determine the great question of the credibility of the Scriptures. But both points are entirely removed beyond the province and scope of natural science.

This indeed had come to be so strongly felt by many sincere and able students of natural science, that it led, some time ago, to an attempt to pledge workers to abstain from all allusions to the Bible, and from all attempts to show either harmony or discrepancy between revelation and science. But this is very like tying up the hands of Christian apologists, and assuming an attitude of timidity and hesitancy, for which assuredly there is not a shadow of reason.

Besides, to refuse to look at the religious bearings of science, and to league against the habit of giving to natural phenomena well-marked theological relations, would not be to check the evil, if it be an evil; it would only be to yield the citadel to the enemy, and dream that we were quite safe because permitted to live beyond the gates. It would be to permit the Word to be buried out of sight under man's knowledge. It would be to put out Samson's eyes, and give him no opportunity to destroy his enemies. The Bible can bear to be looked at in daylight, and to be put to any test by honest men, yea,

even by dishonest men, if those who love it are equal to what God requires of them as his servants, his workmen, his witnesses. Where the unrest is greatest it will step in with its "Peace, be still:" where the billows roll highest, like the sea-bird in the storm or the ark of safety on the wild, dark waters of the deluge, it will ever rise to the top; where the battle rages most furiously it will send its champions into the thickest of the fight. It will ever be seen as most precious when it is set in fullest, brightest light. Diamond-like,

——— "in depths of earth
Long hidden by its weight of clay,
Is, while obscured, of little worth,
But priceless in the beams of day."

Now, when called to deal with, consider, and sift any of those great physico-theological questions, which, whether we will or no, continue to interest the great bulk of the intelligent members of our churches, because of their apparent bearings on revealed truth, we should try to do it in that spirit so admirably described by Augustine, in one of his suggestive notes on Genesis xviii. "If we read anything," he says, "which may produce diverse opinions without damaging our faith, let us not rush impetuously by positive assertion to either the one extreme or the other; lest, when a more thorough discussion has shown the opinion, which we had adopted, to be false, our faith may fall with it; and we should be found contending not for the doctrine of the sacred Scriptures, but for our own; endeavouring to make our doctrine to be that of the Scriptures, instead of taking the doctrine of the Scriptures to be ours." To cherish this feeling will always leave much room for charity, and for respect for the

honest and sincere convictions of others, even when we are ready to enter an earnest, if not even an indignant, dissent from their conclusions. This is not so easy as at first sight it might appear. Our self-will, our impatience of contradiction, our pride, and our deplorable deficiency in that humbleness of mind, before which truth loves to unrobe her beauty and spread out her treasures, are all ready to urge us to denounce those who diverge even an hand's-breadth from *our* views of truth. But a calmer spirit, a more dignified attitude, and a broader charity, are the ornaments of those who love earnestly the True One. May these be ours!

When controversy arises, the state of the question is very much this,—the Bible is accredited with views held to be plainly opposed to scientific facts, directly in the teeth of certain new branches of knowledge. Thus at one time its references to the earth and the sun were held to contradict the astronomical helio-centric theory; its alleged record of a completed creation was said to be antagonistic to the nebular hypothesis; and its account of the origin of all things was believed to repudiate the discoveries of geology. However, let us be thankful that we have got, in the main, fairly right in all these topics; and that only those who are both ignorant themselves, and who believe, that their neighbours are no better, make any use of them, either as refuges of error or as presumed effective weapons against the truth.

But there are other topics on which this kind of accord has not been reached; questions of deeper significance and more difficult to be dealt with; scientific questions, on the corners of which unbelief loves to hang its spoils. Such questions as "the origin of species,"

“the Genesis account of creation,” “the antiquity of man,” “the relation of the embryonic condition of certain forms of the higher animals of the present time to the fully developed analogous forms of geologic time,” the “alleged identity between thought and so-called nerve force,” and the like.

Now it would not be easy to rate too highly sound and intelligent views on these questions. Indeed, they are interesting even from the speculative—the purely intellectual—point of view; and a thorough discussion of them is fitted to put man on his mettle, and to test a great variety of gifts. But is not their interest greatly deepened and intensified when we remember that each of them can, yea, has been, set in lights which at once take a firm hold of popular attention, and cast a spell over many for whose spiritual and eternal well-being the church of Christ is called to watch?

CHAPTER III.

CHRIST IN HIS OWN WORKS.

Remark by Paley—Infidel objection—Discovery slow—Illustrations—Sources of knowledge—"Known unto God are all his works"—All things by Christ—Sovereign control of second causes—Dr. Chalmers on argument for being of God—Distinctions between properties of matter and forces of matter—Illustrations from the coal measures and from the nature and relations of elementary substances—Interest of this field—Forms of simple substances—Law of definite proportions—"My Father worketh hitherto."

"I REMEMBER," says Paley, "hearing an unbeliever say, that, if God had given a revelation, he would have written it in the skies!" The flippancy of the remark could only be equalled by the ignorance of the man who made it. A little insight into even the best known of the sciences, and a very superficial view of, or acquaintance with, the most useful branches of industrial art, would have convinced its author of his ignorance, and shown him how pointless and far from truth such sayings are. It has been ordered that all broad and solid acquirements, even all worthy knowledge, can be reached only in ways which interest the whole powers of man, and enlist them in its pursuit. At ten thousand points, in our following after the highest truth, we are forced to cry out, "Verily, O Lord, thou art a God that hidest thyself!" As, for example, in studying the heart of God revealed in the Bible, and the ways and thoughts of God in providence. In the study of the

works of God this is specially the case. The evidences of the wisdom, power, and goodness of God, to be met with in nature, can never be seen till searched into; never known, till wooed by long watching, patient investigation, and hearty toil. They often lie far out of view. But, even when on the surface, a highly complicated series of relations generally requires to be taken into account, before we can fully appreciate the value of the testimony to certain attributes of Jehovah, rendered by well-known individual instances. Nice, complicated, and fine processes of analysis, are very frequently the road to the understanding of commonest facts, and to the power to set these facts in their very highest relations; those, namely, in which they become true witnesses for God. How long men had to wait before the circulation of the blood was fully explained! Yet, in this fact—in the structure of the vessels for the blood which is the life, in the provision made for its oxygenation, for the removal of those elements of death which float sluggishly in the veins—what an impressive testimony we have to the wisdom, power, and goodness of the blessed Creator! Indeed, illustrations lie around us in thousands.

When we indicate the scope of the subject now under notice we shall understand its limits. The field which stretches out before us, and which invites to thoughtful survey, is both wide and fruitful. There is room in it for many workers, and rich rewards for all. There are harvests to be reaped better than golden. The facts of all the sciences court inquiry, court attention, present themselves to man as if uttering an almost articulate claim to be set in the light of Him to whose goings forth in creation they bear testimony.

Here, then, are some of the sources from which we might draw our materials. The place of our world in the solar system, as related, for example, to the sun and moon, is suggestive of a most interesting class of inductions. The connections between the earth and its atmosphere form the foundation for a great series of Divine co-relations; as, for example, those between the organic and the inorganic world, or between animal life and vegetation, or the links between groups of invertebrates, and between divisions of the vertebrates—fish to fish, reptile to reptile, bird to bird, mammal to mammal; and again, fish to reptile, reptile to bird, bird to mammal. In addition to these there are the subordinate relations in respect of food; as of one animal to another, of certain animals to certain vegetables, and the like. These all offer instruction to inquirers, and court attention. The mode of their testimony varies; but, even as the facettes of the convex mirror, cut on many planes, all reflect the likeness of the one spectator gazing on them, so each of these subjects has, at least, one great truth to present, however varied the lights in which it is set forth—the truth, namely, of the Godhead, of Him by whom they were all created. Let us gather a few of the fruits which hang in richest clusters in every part of a field, which, indeed, is a garden of the Lord, in even a truer sense than was the southern plain of the Jordan, on which Abraham looked down from Mamre before it was scorched and scathed by the fire from heaven.

“Known unto God,” said the Apostle James, in connection with one of the most glorious manifestations of grace in Apostolic times—“known unto God are all his works from the beginning of the world.” Touching

lightly the lines of thought to which reference has already been made, let us see where this expression will lead us. We may take the words as our motto while following some lines in the geologic testimony to the upward working of Jehovah.

When in the study of the works of God we go as far back as science will accompany us as a guide; when as to matter we reach the very threshold of the uncreated, we meet with innumerable proofs of a personal intelligence—ever guiding, every working. Retracing our steps, and following the mighty, ever-deepening, ever-widening stream of realised being—of the building up of the world and of the bringing in of life—we find the same proofs at ten thousand points in geologic history. Everywhere, indeed, it is not substance only, not matter alone that we have to deal with, but substance, matter stamped broadly with the deeply graven seal of mind—of personal intelligence, then, of supreme wisdom, of omniscience, of God! Yes, he stands before the many-sided mirror, and the image reflected from every facet is that of the All-wise. Clouded, no doubt, because of the observer's ignorance, and, because clouded, often standing out in threatening, awful mien, as even the forms of our best loved friends do when they approach us in a mist.

And here we meet a characteristic distinction between the two parts of the one revelation referred to above, for the word and the world are, as we have seen, *one* great discovery of God to man. In the latter, "the invisible things of him from the creation of the world are clearly seen, being understood by the things that are made, even his eternal power and Godhead." But men's natural ignorance casts its influence over even

this revelation in creation. "Their foolish hearts were darkened," the result was inevitable; "they changed the glory of the incorruptible God into an image made like to corruptible man." In the former everything is changed, because we have been lifted to the higher platform, and been guided thereto by another spirit. "We all, with open face, beholding as in a glass the glory of the Lord, are changed into the same image, from glory to glory, even as by the Spirit of the Lord."

Dimness, indistinctness, haze, thus hang over the outward revelation in the material world, so long as the Creator is not seen, and his purpose in all not discerned. While this is the case, we cannot form any right views of Him by whom all things were made. His being, his character, what he loves, and what he hates, cannot be known. But in the other part of the revelation light breaks like a flood around us, scatters the dimness, and shows us the true Creator. Then, what an altered image! Not the face of one to be dreaded, as if shadowed by angry clouds, but of one to be loved; one whom even the Eternal Father himself so highly honoured, and loved, and gloried over as, before angels, to hail him thus—"Thy throne, O God, is for ever and ever." Thus, again, the Father gives us the key to the authorship of all creation. Not only the great globe itself, not only the teeming world of animal life and of vegetation, but the divine beauty, divine usefulness in every part, and the divine harmony in all the parts, as related each to each, and each to all, point to a friend, a brother. The shape and veination of every leaf, the adorning of every flower, the art in the structure of every feather, the painting of every tiny wild bird's wing, and the intricate mechanism in the humblest

mammal, equally with the huge *Adansonia* of tropical Africa—to which Humboldt ascribes an age implying that it stood where it now stands before the tower was built at Babel—or with the New Zealand dinornis, eleven feet high, or with ostrich or eagle, with leviathan or huge behemoth themselves, minutest as greatest, were all the workmanship of Him whose hands on “the solitary Mount” were nailed to the transom of the Roman cross. “All things were made by him; and without him was not anything made that was made. He was in the world, and the world was made by him” (John i. 3, 10). “For by him were all things created, that are in heaven, and that are in earth, visible and invisible” (Col. i. 16). “God hath in these last days spoken unto us by his Son, whom he hath appointed heir of all things, by whom also he made the worlds” (Heb. i. 2). The testimony of Holy Scripture on this point is clear and decided, and shows how little truth there is in the too common impression that earnest and devoted attention to any branch of natural science is inconsistent with simple faith in the Lord Jesus Christ, love for his person, and zeal in his cause. The Father ascribes creation-work to his eternal Son, and should we not love to do so too? This may be fully acknowledged even when we see the Father’s glory as Creator likewise.

In referring here to the geologic testimony to the Creator, we wish, first, to state some things illustrative of his presence amidst, and his control over, those forces which have left traces of their action in the most remote pre-Adamic epochs. Divine presence and divine power, among and over second causes, are here, then, the theme. We would, moreover, carry the

argument farther than the apologists of the early part of this century did, who limited their discussions to the modifications of matter; because there are features to be met with in the seal impressed even on elementary substances, which bring us to the threshold of, if not fairly into, the presence chamber of the Almighty and Eternal God—the great I AM.

“The palpable argument for the being of a God, as grounded on the phenomena of visible nature,” wrote Dr. Chalmers, “lies not in the existence of matter, but in the arrangements of its parts,—a firmer stepping-stone to the conclusion than the mere entity of that which is corporeal to the previous entity of that which is spiritual. To us it marks far more intelligently the voice of a god, to have called forth the beauteous and beneficent order of our world from the womb of chaos, than to have called forth the substance of our world from the womb of nonentity.” But the fact is, the value given here to these modifications—to the evidences of this plastic power—greatly, if not altogether, depends on our being able to trace the working of the same power in regard to these entities, the simple elementary substances whose qualities underlie all phenomena.

In pushing our thoughts farther let us bear in mind the following distinctions:—There is a difference between the properties of matter, that is, inherent specific qualities, and the forces of matter, namely, those qualities brought into action—elicited, discovered, by collocations, by adjustments, by such arrangements as develop mutual relations, guided and dealt with according to ever-working law. These forces, again, are to be distinguished from what is styled “the laws of

nature," an expression which is used in a highly popular sense, and means no more than the *continued* action of such forces.

Let us take, as our first illustration, the interval between the point of time when a provision was made for the growth of the rank and remarkably luxuriant vegetation peculiar to the coal measures, and the point at which the Divine Worker was to bring the coal within man's reach; the period between the mountain limestone below, and the Permian above. It is one of peculiar and deep interest on many accounts. The limestone occurs in wide areas; in some places it is more than two thousand feet in thickness. During the time of its formation the waters of the ocean and of the estuary must have been heavily charged with carbonate of lime which yielded material to the myriads of polypes with which to build themselves houses. Conditions prevailed wholly unlike anything that we can trace between that period and the true beginning. As the giant ages rolled on and upward, the coal measures proper came into existence. Now how complete, how thorough, how absolute must have been the control over natural laws in order to this result. How gloriously manifest the Divine presence in order to all the adjustments necessary to this change. (1.) A soil differing very widely as to chemical constituents from all previous soils had to be provided. (2.) An atmosphere, like to which nothing exists in our epoch, had to be hung over God's green earth—an atmosphere holding carbonic acid in a proportion fatal to most, if not to all, true forms of land life. Whence this soil and whence this vast abundance of carbonic acid? For in the full knowledge of recent objections we still hold that both

the soil and the atmosphere of the coal period were unique.

The waste and wear of previously existing rocks, throughout long ages and under changeful climatal conditions, might be used to prepare the soil. As regards the preponderating presence of carbonic acid, we can do no more than guess at the likelihood of the action of complicated processes in natural chemistry, associated with the formation of the mountain limestone, as the most likely way by which this peculiar atmosphere was prepared for the support of the rank vegetation which flourished in the immense water-locked, low, swampy plains of that period. But this uncertainty as to the source, only raises our admiration as we look at the marvellous results. A vegetation was realised, adjusted to the atmosphere, which in its turn found in the vegetation the divinely appointed organisms fitted to reduce it, to appropriate it. By a precisely similar process, but on a far grander scale, to that illustrated in the relation of our present vegetation to its surrounding atmosphere, the carbonic acid in the air was received, fixed, and stored up as carbon, the principle of true wood in the plants. Great ages of luxuriant growth glided by. The treasures for the store-house were provided, but were not yet laid up in their places. But the storing time came. The unseen hand took the control of the forces, which by his power were called into action—awakened from a long slumber and sent forth to do His bidding, whom all must obey. The densely wooded plains, and the rank jungle which covered great areas, sank out of sight. Moist for a season with the waters which in wild violence had rushed over them, they were buried deep in the earth's crust, and

laid up, there to wait for other changes, as remarkably illustrative of the controlling presence of the Almighty as those which had preceded them. The saturated earth was to become a great laboratory. As the vegetation gradually decomposed, carbonic acid gas was evolved. Oxygen came to be set free, and the first great stage in the process was reached; the decomposed vegetation became *lignite* or wood coal.

But at that point natural chemistry had not done more than begin its work; it had only begun to give the promise of those remarkable results which have brought, directly and indirectly, so much blessing to man. Conditions, again divinely realised as the fruit of the still upward working of the unseen hand, are brought about, by which the lignite parts with its over-charge of hydrogen, under the well-known form of carbureted hydrogen, and what remains is common coal. For other ends the action of all these varied forces had been so modified at one point and another, at one period and another, as to have left illustrations of the conditions of the material at every stage of the process necessary to the production of pure coal. These are all as well marked as are the products which coal yields to the chemist in the process of destructive distillation. Now, as regards the natural process, at any other stage than that at which the fuel was laid up in the earth, and in any other condition, coal would have been comparatively useless in the industrial arts.

The face of the earth was again changed. Plains once more stretched out in the sunlight, clothed once more in beauty, but for the most part having a widely different vegetation. Little hills rejoiced before the Lord. Huge mountains touched with their lofty sum-

mits the clouds. How was such a change produced? There were wild upheaval, and rocking earthquake, and the violent action of tremendous physical forces which shook the solid earth to its foundations. These were chiefly caused by the escape of those gases to which reference has been made. They needed to be set free in order to the preparation of the coal, which sheds comfort in quiet homes, which sheds light on loving faces when the darkness is deepest all around. Yea, they needed to be set free in order that another product, itself the fruit of yet more wonderful natural agencies, should be put within the reach of men; a product for which gold, had we mountains of it, could never be a substitute; whose help all industrial art demands; without which there could have been none of the highest forms of civilization—even iron, which goes alike to form the pen with which we write, the steam-engine of land and water traffic, and the thick-ribbed walls of the deadly Armstrong gun! The eater is everywhere seen giving meat—the strong one sweetness. The vegetation of the coal measures was prepared for another age. The physical conditions of the earth at that time were realised, in order to the highest ends of usefulness and beauty in the present condition of things.

These same forces, then, which elevated mountain ranges, which in some places reversed great series of strata, which in others lifted them from the plain of the horizon, setting them at various angles to it, or even assigning to them a vertical position, were our heavenly Father's ministers. By them he put the coal and the iron within our reach. Yet, even while standing in the midst of these results, and even while attempting to

guess at, if not to estimate, the measure of the forces connected with them, there have been many students—yea, able students—who have not had power to see anything more than what they have loved to name “abnormal forms of the action of natural law.” They have not bared their heads or stood awe-stricken in the presence of an almighty personal Worker.

Trying to account for this state of mind one gets sadly puzzled. Yet why should we? It is not more wonderful than is the fact, that even the same minds should have so often, in the present times, been duped by the childish follies of spirit-rapping and the silly superstitions of table-turning. Present to such persons the most imposing forms of truth, or shut them most closely in by the walls of well-set reasoning, they will manage to miss all the good which accrues therefrom to others. They cast the shadows of their prejudices forward on truth, and refuse to bow to it unless obscured by these. Nevertheless, but for the evil case and bad condition in which some workers are, comparatively little prominence would have been given to the phenomena at which we have glanced, as fruitful in every aspect of evidence of the presence and directing energy of an all-wise and almighty One. The denial leads to the fuller illustration of the truth denied, and the proofs of the constant care which the Creator throws over his works come to be multiplied, whenever doubt is cast on their existence. The evil beginning thus is hastened to a good end. Where we dreaded disaster, we reap the fruits of success.

“I have seen
The thorn frown rudely all the winter long,
And after bear the rose upon its top.”

Leaving, then, the geological testimony to the presence, throughout all the periods of the earth's history, of a directing personal Will, we glance at another aspect of truth, lying further out of sight, and associated with more remote phenomena than those hitherto reviewed. We seek now for marks of divine wisdom, in the preparation of those elements which enter into the phenomena by which the directing care and controlling will of Jehovah have been so signally manifested to thoughtful men. We are here taken much farther away from the complicated effects of manifold adjustments, and are set to watch at the very brink of creation itself. We are led into a field of observation to whose edge geology leads us, and where it leaves us in order to give place to inorganic chemistry as a guide. If we follow reverently, as true students ought to do, we shall not fail, we cannot fail, to see a divine Will and a glorious Personality, at the most remote point to which we can carry our science. We are indebted to inorganic chemistry for a knowledge of those elementary substances from whose combinations, relations, and adjustments, such grand and striking effects as those at which we have been rapidly glancing have been produced.

In number there are about sixty substances which are held to be elementary, simple, undecomposable. Were the history of this list written; were the labours of the highest intellects on it recorded; were the grounds on which, at one time and another, some elements have been removed from the list duly chronicled; were the relations of beauty in which they have been seen fully sketched;—were all this done in language becoming the theme, we should have a chapter in science more fascinating far than fiction. When some one shall arise

who will bring to his theme great scientific attainments, a painter's eye, a poet's imagination, a Christian's heart, and withal the power to wed his thoughts to the rolling music of Milton's verse, or to the artistic beauty and stateliness of Dante's, we shall have a hymn almost worthy to be offered to the Creator himself.

In glancing at the divine wisdom revealed in the preparation of these elementary substances, we are first struck with their forms. Some of them are solid, some fluid, some gaseous. Had they been all met with under any one of these conditions alone, the present creation could not have been realized. These forms or conditions were intentional. They are the results of creative forethought. They were then, from the beginning, designed for higher ends. Yet these ends could not be reached except by combination of elements, by collocations, by adjustments. They were thus originally designed for this very use.

Here again nothing is fortuitous—nothing haphazard. The very mode in which they will go together, unite mechanically, incorporate (if we might so say), has been made the occasion of bringing out an unalterable law—a law determined when they were created. No skill, no perseverance, no power of the chemist can alter that law of definite proportions under which they all are. Yea, so thoroughly fixed, so unalterably stable is this original property—this evidence of the direct imprint of creative will—that it meets you, not in primary compounds merely, but even in most complicated ones also. From the point of view of present knowledge, you might as soon expect to destroy the individuality of the rational will and break down all distinction between the right and the wrong, the good and the evil,

as to change this chemical law. Deal with these elements as you may, subject them to the severest tests, still the invariable analytic results will point to the law as something completely beyond man's power. Now, let us ask sincerely, "What is the legitimate inference here?" Is it not of necessity this—When you have pushed your inquiries farthest back, when you have reached the point which lies on the very threshold of the uncreated, the unrealised, you meet with clear, bright proofs of intention, of mind and will, of personality, yea, of the true and living God himself, above and amid all these substances.

But this is very far from an adequate statement of the case. Watch the important part which several of these simple, undecomposable, elementary substances, have played in the organic world from the very morning of life—from the time when those simple forms lived which have left traces of their presence in the Laurentian rocks—from the time when the pretty *Oldhamia antiqua* floated in the waters in which the Cambrian series of rocks was formed, and when the *Arenicola didyma* burrowed in their moist sands, up to this present hour, and the teeming life which characterises our period, and notice the every varying forms under which these unalterable proportionate relations occur, and can we resist the conviction, that their Creator gave to these elementary substances proportions which no power of man can set aside and no influence of natural law explain? It is impossible. But there was an end in view. That end was animal life and vegetation in geologic ages as in the present time. Now, from the moment at which these unalterable properties were communicated, the manifestation of Him who did

so has been increasing—has been ever upward in order to a fuller discovery of his own glorious character. Does not all this let fresh and unexpected light on the testimony of Him who had been with the Father from the beginning, “as one brought up with him”—the testimony even to this, “My Father worketh hitherto”?

Take an illustration of this point. (1.) Suppose, for example, that we had started from the point of view of chemical combination by weight, the application of the law alluded to would show us, that all bodies which can unite with other bodies in several proportions have properties which are marked by definite simple relations to each other. (2.) While the same chemical compounds contain the same elements in unvarying proportion, it is ever to be kept in view, that the same elements in uniting do not necessarily produce the same substance. Here other considerations must be recognised. The mode in which the union takes place, the circumstances under which it does so, the relations of the separate elements, or of all the elements to each other, and to associated though not incorporated elements, on the one hand, and the design of the person, divine or human, working with them, on the other hand, must all be taken into account. Thus only can we explain that wonderful diversity of form which everywhere meets the eye in nature, and which is all the result of the chemical combinations of a very few elements. (3.) This diversity is not limited to form, it reaches to properties also. It is here, especially, that the action of this beautiful law is most manifest. Suppose you take the compounds of nitrogen and oxygen, and so describe the proportions that one of them shall always remain the same. Nitrogen is, say, marked by 14, and oxygen

by 8, the number representing the quantity of that substance in the first compound. Thus the oxygen in the protoxide, the first compound, is 8, and the nitrogen 14. In subsequent combinations the nitrogen remains the same, and the quantities of oxygen increase by multiples of 8. Thus binoxide gives nitrogen 14, oxygen twice $8 = 16$. Nitrous acid gives nitrogen 14, oxygen thrice $8 = 24$. Hyponitric acid gives nitrogen 14, oxygen, 4 times $8 = 32$; and Nitric acid gives nitrogen 14; oxygen 5 times $8 = 40$. (4.) If we carry our researches into chemical equivalents, this law of definite proportions is even more strikingly seen. Taking oxygen, again, as marked by 8, and using it as a representative, because of its wide range of affinity and its susceptibility of exact analysis, it will be found that every element with which it combines has an invariable proportion in relation to 8 of oxygen. Thus the equivalent of hydrogen is 1, because only 1 of hydrogen will join with 8 of oxygen. You may alter, at pleasure, the representative number, but you will always get the same proportion. Thus, suppose you make oxygen 100, hydrogen would be 12.5, which is just the proportion; as 1 is to 8, so is 12.5 to 100. The equivalent of nitrogen, again, is 14 when oxygen is marked 8; it is 175 when oxygen is taken as 100, and so throughout a numerous series. Hydrogen and oxygen, nitrogen and oxygen, carbon and oxygen, phosphorus and oxygen, &c., invariably combine in definite proportions. The term *equivalent* correctly expresses the law, for it is applied to a quantity capable of replacing another quantity in combination. Oxygen being 8, one part of hydrogen goes as far in combining with, or saturating the oxygen, as 14 parts

of nitrogen, 35.5 of chlorine, or 127 of iodine, or 31 of phosphorus would ; these numbers marking the equivalent substances. Now, it does not say much either for a man's intelligence or his common sense, if he can either believe or can say that this law is fortuitous, and that it does not bear on it the broad mark of personal gift and control.

Before we pass from this subject, let us state briefly the truths we have been seeking to dissociate from those cross and uncertain lines of thought in which they are so much entangled, and which we have tried to illustrate by the light of science. We have followed the footsteps of a Divine person, willing, working, and controlling according to a sovereign will. We have seen him guiding great forces all through one of the immense periods of geologic history, and leading them to ends as remarkably illustrative of divine, beneficent forethought, as they are of the grandeur and majesty of the glorious Worker himself. A glance at the elements which have borne a leading part in order to these results, shows us the seal of the same All-wise One impressed on them, sunk deep into their very essence. He who gave to these elements the properties characteristic of each, and who determined their union with one another by a law of definite, unalterable proportions, must have been before them, above them, over them, as their guide. And thus, when we travel beyond Eden, beyond the world on world,

" With other powers
And other forms of life than ours,"

whose history is written on the fossiliferous rocks, yea, beyond the lowest rocks themselves, and stand in

thought on the edge of the true beginning, we cannot open our eyes, we cannot examine intelligently one particle of matter, or one true elementary substance, without being constrained to recognise will, forethought, personality, as before all creation; the uncreated One, Jehovah himself.

Starting from this standing point, the evidences of the presence of a Divine person in guiding natural laws, in adjusting their action to the support of new species, and in causing antagonistic natural forces to work out remarkable harmonies, might have been pushed much further, and into other relations, but let these suffice as casting light forward on our Lord's words, "My Father worketh hitherto."

CHAPTER IV.

ARGUMENT FROM DESIGN.

“God created all things by Jesus Christ”—Special adaptations—Correlations of structure—Cuvier’s law—Bridgewater-treatise point of view—Structural differences between carnivorous and ruminating animals—Quotation from Aristotle—Evidences of progress—Photography—Objection to argument from special adaptations—“Consider the lilies”—Presence of a personal God in nature—Illustrations of Gen. ii. 7; Eccles. iii. 20, &c.—Man and the earth—Man’s dependence on elements in oldest rocks—The animal and the vegetable—Wheaten flour—Discoveries of MM. Dumas and Bousingault—Adaptations.

WE take as our text and starting-point here the words, —“God created all things by Jesus Christ;” “By him were all things created that are in earth;” “All things were created for him and by him,” “That now might be known by the church the manifold wisdom of God.” We do not limit the words to the “visible;” they include the “invisible” also. The sovereignty of Christ over the whole spiritual world, his presence in providence, his gracious rule in the church, his control of all things for the good of the individual believer, are all covered by these expressions. We have now, however, to do with “the visible things,” which yet cannot be understood if studied by themselves. They must be regarded in the light shed down from above; they must be associated with the will, and, shall we say, the heart, of the supreme and eternal God. To attempt to regard them as isolated and removed from

that light, would be to find ourselves in the heart of controversy, in the midst of vexations, uncertainty, and unrest, dealing with creation as if it had no creator. The former method leads to peace. The contrast is as great here as in Raphael's grand picture of the Transfiguration. Below, under the clouds, at the foot of the Mount, all is confusion and the helplessness of unbelief. The world is seen sneering at the disciples, whose want of faith makes them powerless as to the great work expected from them. In their Lord's bodily absence they should have been able to give proof of their nearness to and fellowship with Him whose will controlled all matter, and who could cure all physical suffering—suffering resulting from the power of another will, by which confusion is wrought both in matter and in mind. Above, beyond the clouds, on the brow of the hill, among the sunlight, all is order, and rest, and peace, and tempered glory. The disciples failed because they realised not how very near they were to Him, the head, and source, and fountain of their strength. We must keep the "visible and invisible" together, even when we search into one branch. If we concentrate our attention on "the invisible," we become poor speculatists, dreamers, mystics; if we limit it to "the visible," we become dry, hard materialists, self-centred worldlings, seeing no God, above, around, below. But God's wish is, that even as he, in bringing out the glory of his Son, links up both as if they were one, by simply revealing him as "Lord of all," so should we be forward to give prominence to the personal Will which underlies all phenomena, and which indeed assumes phenomena as a royal robe in which the Divine One himself appears to man.

The student of natural theology has hitherto sought for his chief treasures, arguments, and weapons of defence, in those special adaptations of means to ends, which, especially in organic nature, crowd on the intelligent observer. The argument from special adaptations can at once be set in highly influential popular aspects; whilst their correlations, deeper and more difficult of appreciation, would fail to interest men. This has, of course, and perhaps rightly, determined the direction which the majority of workers are likely to take. A great work is to be done; men are to be guided out of the dreary dark into God's bright light; they are to be brought back to God; but life is short, and the readiest methods are almost sure to be the favourite ones. There will, however, always be some who will go deeper, and bring up what we believe to be the higher kind of testimony.

Let me illustrate this. "Every organised being," says Cuvier, "forms a whole, a single circumscribed system, the parts of which mutually correspond and concur to the same definite action by a reciprocal re-action. None of those parts can change without the others also changing, and consequently each part taken separately, indicates and gives all the others." The principle stated in those words is that of the now well-known correlation of animal forms and structures. The application of this principle is much more difficult, it demands a much more intimate knowledge of the individual parts of animal structure, and of their relations to homologous parts in other animals—and must be associated with a far higher power of generalisation than can be looked for, or is even necessary to the discovery of adaptations between this or that peculiarity

of structure, and the habits of the animal in which it occurs. Take, for example, the canine teeth of the tiger, and notice how accurately and thoroughly adapted they are to seize, to hold, and to tear the animals on which it preys. If a skull turn up in your rambles, in which you meet with the same form of teeth, more or less modified perhaps, you associate these with habits corresponding to those of the tiger. This kind of teeth is peculiar to the carnivore, you say, and you see in this an illustration of the wisdom and goodness of God. Thus far the argument from special adaptation. Beyond this the apologists of the early part of this century—the authors of the “*Bridgewater Treatises*,” for example—seldom went. But carry your observation to the whole skull, and look next at the trenchant teeth which lie behind these canine ones. The position and form of these indicate that, if they are to receive the canines, their points must not meet, but overlap. They must act as scissor-blades over each other, and to be effective must have a provision which shall do for them what the close-fitting pivot of the scissor-blades does for them—keep them close together. If, in case of the scissors, the pivot be loose, cutting is either impossible, or must be done in a very slovenly way. Follow then the bones farther back, and you notice a process, or condyle, which articulates with the skull proper, and fits very closely into a corresponding hollow in the hinder part of the skull. These bones are associated with powerful biting muscles, which keep them as tight as if pressed on both sides with strong double elastic springs, and thus their movements must all be on one plane. They could not perform the half-rotatory movements which their homologous or corre-

sponding parts in the ruminants do. A little closer observation shows that the plate of bone, known as the *coronoid process*, which affords the surface of attachment to these biting muscles, is fully developed, broad and high, while the surface on the skull where the chief biting muscle arises is large and deep, and marked by a high ridge of bone,—everything pointing to strength, to compactness of parts, to great power in the organs.

But leaving the bones of the head, and looking at those of the fore-leg, you are at once struck with peculiarities which distinguish the fore-leg of the tiger in a way most broadly marked from that of the ox, or stag, say. The blade-bone differs, so does the thigh-bone, so the bones below the elbow—the radius and ulna—and so do the bones of the feet. Carrying your researches and comparisons farther, it is discovered that the form and structure of the teeth in every case determine the form and structure of the fore-leg, or are determined by them, for the relation is reciprocal. Or starting from the observation of evidence of a retractile claw, or from the condyle, or projection of the blade-bone, or from the mode in which the radius and ulna are joined, or from the mode in which the condyle of the lower jaw articulates with the skull, or even from the form of a single tooth, you can, in the application of this principle of correlation, determine, not only what must have been the character of the bony skeleton, but what must have been the kind of the digestive and other organs, and what, too, the habits of the animal; whether it was a carnivore, or a vegetable feeder, or an animal accustomed to feed both on flesh and on vegetables. This principle may be applied to the whole animal creation. All are aware of the grand pur-

poses to which Cuvier put it, in determining the forms and habits of animals which belonged to geologic time, from individual parts. And all know how, in ninety-nine out of every hundred cases in which Cuvier described animals, a small, and often, seemingly, subordinate part of which had at first been brought to him, when all the parts were discovered in the progress of science, his opinion was found to be correct. Now, we do not exaggerate the importance of this when we say, that it has opened up to the natural theologian a field suggestive of truth in every corner of it—a field like to which he had known nothing previously.

Pursuing our investigations from this point of view, we are led far beyond those outstanding adaptations open to the notice of all, and have revealed to us in the deepest forms of animal structure, features of mutual dependence of parts, and of the relations of widely different organs, which at ten thousand points shed light on the presence of the Divine Worker. We see creative forethought under new and richly varying lights; we meet everywhere with plan, from which, while there is no divergence, there are yet such modifications as point to specific differences, as constant in the individuals as the plan is manifest in the groups.

In a fragment of Aristotle, preserved by Cicero in his "*De Natura Deorum*," the full approach of the Gentile mind to the true appreciation of the argument from evidences of design is stated with great beauty. "If," he says, "there were beings who lived in the depths of the earth, in dwellings adorned with statues and paintings, and everything which is preserved in rich abundance by those we esteem most fortunate; and if those beings could receive tidings of the power and

might of the gods, and could then emerge from their hidden dwellings through the open fissures of the earth to the places we inhabit; if they could suddenly behold the earth, and the sea, and the vault of heaven; could recognise the expanse of the cloudy firmament, and the might of the winds of heaven, and admire the sun in its majestic beauty and radiant effulgence; and, lastly, when night veiled the earth in darkness, they could behold the starry firmament, the changing moon, and the stars rising and setting in their unvarying course, ordained from eternity, they would surely exclaim, 'There are gods, and such great things must be the work of their hands.'"

These views came in course of time to be carried into other and more limited departments of nature than those so forcibly referred to in this extract. Busy workers entered the field, which, even to the heathen, seemed so fruitful and full of interest. And, scattered over the early literature of Christianity, you find many proofs of the readiness with which the mind enters upon the study of anything in nature which testifies to the presence of a designing and controlling One. But the argument was long limited to adaptations lying on the surface of things—to phenomena with which all were familiar who chose to open their eyes. It remained for recent students of science to push their inquiries into quarters more remote—to deal with phenomena lying farther out of sight, to lay under tribute the deepest relations and correlations of animal structure. The result has already been a rich testimony to the personality of God, and to His goodness and greatness of whom it is said,—

"The sea is his, and he made it;
And his hands formed the dry land."

But the evidence has only begun to gather. Much land remains to be possessed ; many fruits, richer and riper than all gathered before, remain to be brought in. As science advances, the demand for competent workers on the side of truth increases. It is, indeed, here very much as in the mechanical branches of purely physical science. Every mechanical invention lays the foundation for other inventions ; every contrivance is a step to other contrivances ; for in each, suggestions occur of applications of the different parts before undreamed of. New relations of parts give rise to other relations, and they, in their turn, serve the same end. In most pieces of complicated mechanism, the characteristic parts become so many hints of their own application and fitness for other ends than those which they hold in the individual piece. In like manner, almost any discovery in art contains the prophecy of many more discoveries. The history of the steam-engine very fully illustrates the former, that of photography the latter. What a story is that of the applications of the science of thermodynamics since 1824, when Carnot published his essay, "Reflections on the Motive Force of Fire," up to the present day ; and how suggestive from this point of view is the progress of photography since 1802, the true birthtime indeed of this interesting art, when Sir Humphrey Davy published, in the *Journal of the Royal Institution*, "An Account of a Method of Copying Paintings on Glass, and of making Profiles by the Agency of Light on the Nitrate of Silver."

The change indicated here, and the gradual steps which led to it, are not more remarkable than what is now to be noticed in the department of Natural Theology, brought about chiefly by Cuvier's enunciation of the great law of

unity of plan in certain groups of the animal kingdom, and the application of the principle of correlation to the true interpretation of all the parts of individual animals.

It has indeed been alleged, that the value of the testimony of special adaptations to the wisdom and goodness of the Creator is weakened by the circumstance, that it very much depends on the student's previous acquaintance with mechanical contrivances—that, in fact, it would have been nothing without this. But it is just here that we find much to set this doctrine in its most powerful and interesting relations. Mind, spontaneously acting, seeks through observation to gather together phenomena with which reason shall deal in discovering their nature, and in unfolding their relations. Thus acting, mind no sooner sees results analogous to the fruits of its own working than, by a law which it cannot resist, it traces them to another mind. If then we find in nature phenomena of fitnesses, of remarkable harmonies, as radiant with evidences of a present working, guiding, superintending mind, as in any of the simpler or the more intricate fruits of man's wisdom in mechanics, or in the industrial arts, to what conclusion can we come? Must we not seek to associate these evidences of mind with a living person? Must we not seek to know all that can be known about him? Would it be in any sort unworthy of us, even if we should try to find grounds for loving him? And should we not be true to ourselves, as it certainly would be safe, to cry out for more light, if we found our inquiries, when pushed to the utmost in this quarter, land us deeper in the darkness as we follow the light of nature farther? Would it not be as manly, as it would be safe, to welcome that revelation of God which is above

nature; and to say after all our wanderings and uneasiness, after all our questions and all our sustained studies, "Here will we rest"? The inference from these fitnesses that a personal God, wise and loving, is present in his works, is as irresistible as is the inference from the examination, say, of the air-pump, that its construction is the fruit of personal human skill.

Now, it lies as a duty on every Christian observer of the works of God to make use of this argument for the very highest end, even for the enforcement of great spiritual truths touching creation and providence, which are ever suggestive of the near presence of God. And many may wield the power as those who know their ground—who know the limits and weakness as well as the value and strength of the argument!

See how our Divine Master used it! See how he set forth the art of God in nature alongside of the wisdom of man in art, in such a way as to make the former "a grappling band to knit the heart to God." "Consider the lilies *how* they grow" (*πῶς αὐξάνει*), in what manner they add part to part and develop throughout the whole. "They toil not, they spin not; and yet I say unto you that Solomon in all his glory was not arrayed like one of these." Solomon's royal robe was rich with the fruits of many minds working thereto; but what was it when brought into comparison with even the lowliest of the works of our heavenly Father, "who so (*οὐτως*) clothes the grass of the field"? Thus the need of practical knowledge; for this appeal can only be made effectively, and to profit, when we speak of what we have ourselves examined, searched into, and in some measure understood. In any department this is true. Suppose

that all the knowledge we had of the microscope consisted in having heard, in a very general way, of its structure and uses. Would this equal in value the knowledge gained by using it? Or would this, again, be as influential when we should be called on to describe it to others, as the experience got in taking it down piece by piece, and in building it up again? More; would not our power over it be increased, if we had seen the brass and the steel formed from the shapeless lump into tubes and wheels, the lenses adjusted to the vision, the power of each determined, and its visual range, when associated with the others, definitely fixed? In the study of science it is the same. If we would set its fruits in the highest aspects, and press them into the service of the sanctuary, we must have, to some extent, a practical insight into those works of creation which supply so many evidences of the presence, power, and personal control of the Creator.

It is, no doubt, sadly true that many workers see these evidences of design, but no designer; many acknowledge the influence of contrivance, in the continuance of order in nature, who are forward in withholding the recognition of the presence of a person, and of his working in order to this. There is no explaining this; except, indeed, that moral features make "the wish father to the thought," that God is not in his own temple, and takes no charge of his works. But sadder than this is the fact that multitudes look eagerly to such quarters for guidance. They look in vain! Such guides will never lift them up out of the dreary dark. Thinking of this, one is reminded of that part of Jean Paul Richter's well-known terrible dream, where he says, "I passed through unknown shadows on whom ancient centuries

were impressed; they were all standing around the empty altar. On the church dome was a dial-plate whereon no number appeared, *but a dark finger pointed thereon, and the dead sought to see by it.*" Yes! unbelief is as old as creation. Ungrateful, it brings no gift to the altar; its finger points only downwards to the dark, and *they* lose all who follow its direction. But we have an altar which is not empty; for we have laid the offerings of love and service where our Redeemer once lay. We have a better guide; the finger of the living God points, and all who follow it find themselves led up to the light, yea, into the very presence of their heavenly Father himself.

Let us turn, then, to some of those adaptations which bear striking testimony to the presence of a personal God in nature. Illustrations of this on a large scale have already been noticed, in the review of that work of superintendence implied in the introduction and guidance of great geologic epochs. We saw the dependence of organised being—animal and vegetable—on the inorganised soil and atmosphere. So many and so varied were the lines seen to be which all terminated in man, that we were shut up to the conclusion, that the highest and yet the truest view of the physical world is, that it was formed for man. If this be so, and no doubt it is, then the Creator had moral ends in view, to the furtherance of which nature was divinely adapted. We wish here to state this more fully; its discussion is pleasant; its testimony to creative forethought is decided, strong, unambiguous. Its one outstanding lesson is, that the Divine Worker is more than almighty—he is all-good, all-wise.

Take these texts as our starting point here: new light

will break in upon them as we proceed. "The Lord God formed man of the dust of the ground," (Gen. ii. 7). "All go unto one place; all are of the dust, and all turn to dust again," (Ecces. iii. 20).

In the application of inorganic chemistry to the soil, fourteen ultimate elements are isolated as constituents, which assume a relation of deep interest when looked at from the present point of view. These are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulphur, chlorine, silicium, sodium, aluminium, calcium, iron, and magnesium. Now, organic chemistry, dealing with the various solids and fluids in the body of man, has, by careful and rigid analysis, revealed to us the fact, that, all these, in various conditions and in various combinations, are to be met with in man's body. Their presence there is the proof that they were the elements divinely allotted to the construction and the support of man's body, originally and naturally the place of God's in-dwelling, and once more, in grace, to become God's home on earth: "I will dwell in them." The soil was thus adapted to the highest end, save one, to which it could ever be applied; namely, being formed into a body for man. The highest of all ends, however, being its use, under the power of the Holy Ghost, to yield a body to God's eternal Son: "A body hast thou prepared me"—a dust-formed body, endowed, as to these elements, just as ours are.

Again, the individual dies, but the race lives on: "All are of the dust, and all turn to it." But this "turning to it" is not unfruitful. It is the restoration of the inorganic elements to the dead material soil, in order that they might hasten once more into their highest relations, and in other organisms perpetuate

the race. But "many that sleep in the dust shall awake." "The dead shall rise again." It is a miracle, great as the resurrection, to see these elements again in living bodies. The resurrection of the great day itself will be the highest of all miracles, for it will be the testimony that Jehovah can preserve individuality, maintain the personal identity of each of his people, while dispensing with the elements to which reference has been made. "It is sown a natural body, it is raised a spiritual body. There is a natural body, and there is a spiritual body."

Our inquiries, when pushed into remoter quarters, open up to us relations of fitness deeper even than these. Bear in mind that the plant has ever preceded animals in creation. Not only does God, as the witness to his own work, state this precisely and clearly, in Genesis i., but the great book of nature, even in the earliest chapters which deal with geologic time, point in the same direction. The plant has lived without man. Man cannot live without the plant. "Each moss," says Thomson,

" Holds a rank
Important in the plan of Him who framed
This scale of beings, holds a rank, which lost
Would break the chain, and leave behind a gap
Which Nature's self would rue."

But the poet's words fall far short of the mark to which we point. One or two details must be attended to, before the Divine wisdom in the adaptations now in view can become brightly manifest.

In certain districts whose soil is chiefly decomposed lava, remarkable richness and luxuriance of vegetation have been observed. Treated chemically, among other constituents, a considerable amount of phosphoric acid

is obtained. When the red, scoriaceous, recent lava of Vesuvius is treated in the same way, like results occur. Passing the soil and the recent lava, and applying the same analytic method to the oldest igneous rocks, the observer is struck with the fact, that in them also traces of phosphoric acid are noticed. In the course of his inquiries into the same class of unstratified rocks, he finds—as, for example, in certain felspathic, and in some micaceous minerals, another element already found in the soil, namely, potash. When felspar proper and bi-axial mica are dealt with, the fact of the presence of potash cannot be doubted. Phosphorus was discovered so early as 1669 by Brandt of Hamburg. It was not till 1807, that Sir Humphrey Davy isolated potassium as an independent constituent of the soil. Their presence in the soil results from the disintegration of those rocks to which reference has been made, rocks which, though having representatives formed in recent historical time, yet lie nearest of all other rocks, to the beginning, the point farthest removed from present history. But plants droop and die if these elements be not supplied to them. Where they exist in due proportion the soil is most fertile. We come, then, to see their value for the plant.

The first creative step associated with the bringing in of matter, gave to the rocks their elements. The rocks by original constitution were fitted for supplying the food which the first vegetation would at once demand. They were then, 1st, adapted to the vegetation when created ; and, 2nd, as elements they require to be set free sparingly and at intervals. The nature of the rocks in which they are found is such, that all the wear of water, and all the wasting influence of atmosphere

cannot do more than furnish them in very small quantities to the plant. If supplied in large quantities they would be hurtful. The measure obtained, the result arrived at, being the fruit of a previous adaptation, the outstanding work of creative forethought. The vegetable could not live without these; nor could the animal; nor could man who is at the head of all. There is not a plant on the earth in which phosphoric acid and potash do not occur. In some of the most useful, the proportion of phosphorus is minute; yet, if you remove it altogether, their power to nourish the animal frame is lost. In wheaten flour, for example, to every 1,000 parts there is not more than one of phosphorus; yet were the flour destitute of this, it could not assist in the formation and growth of brain, and bone, and nerve. With this it is useful in the highest degree; without this it is useless.

The series of adaptations increases. "He causeth grass to grow for the cattle, and herb for the good of man." "And God said, Behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree in which is the fruit of a tree yielding seed; to you it shall be for meat." "Every moving thing that liveth shall be meat for you; even as the green herb have I given you all things." Thus, again, the Divine creative forethought. The phosphorus and the potash, on which the vegetation of the very earliest epochs depended, equally with that of our own, were laid up in the earth to wait the day of their being needed. A vegetation was created fitted to appropriate these from the soil. Man eats the green herb or the animal which has eaten it, and these elements enter into his constitution. The solid parts even of our Lord's

body, were made to depend on those very substances, which he had hidden in the bowels of that earth whose foundations he laid. In how many new lights may the words of the wise man be put—"God requireth that which is past!"

The closest relations thus exist between the vegetable and the animal, and the dependence of each on the other is very broadly marked. Nevertheless they are distinct. Each has peculiar offices assigned to it in the scheme of nature, which bear on their face a protest against every attempt to blot out the line of separation, as if all life were one, and as if the so-called vital forces which work in vegetation were generically the same as those met with in the lowest forms of animals. Thus the importance of keeping the distinctive functions of each before us, if we are to appreciate the evidences of divine wisdom in these relations. The difficulty of scientifically defining the difference, is acknowledged readily by most, and is, no doubt, great. Perhaps, however, organic chemistry supplies the most satisfactory statement, whose importance will appear as we proceed. The well-known and highly-accomplished French chemists, MM. Dumas and Bousingault, published in the *Annales de Chimie*, in 1842, an admirable characterisation of the chemical difference between the plant and the animal. In their programme of lectures on organic nature the leading facts are stated thus:—"An animal, in a chemical point of view, constitutes an apparatus of combustion, by which carbonaceous matters, burnt incessantly, are returned in the shape of carbonic acid; in which hydrogen, burnt incessantly, is returned as water; whence, in fire, free

azote is ceaselessly exhaled in the breath, and, in the state of oxide of ammonium, is thrown off in the urine. On the other hand, vegetables, in their natural and healthy state, decompose carbonic acid incessantly, fix the carbon, and set free the oxygen. They decompose water, seizing on its hydrogen, and disengaging its oxygen as before. They either abstract azote directly from the air, or take it indirectly from oxide of ammonium or nitric acid, thus acting in every particular inversely, or in opposition to animals." We cannot fail to see here, that, regarded from the chemical point of view, the difference between the plant and the animal is well marked; but the constant interplay of phenomena, the strongly marked inter-actions, the striving of apparently antagonistic forces, and, withal, the harmonies which result therefrom, present to us subjects of thought as beautiful as they are true.

CHAPTER V.

THEORY OF LATENT VITALITY IN MATTER.

Refusal to acknowledge the testimony of special adaptations—Old scientific heresies—Origin, growth, and energies of living forms—Creative energy—Vital phenomena—Phenomena of intellect and will—Quotation from Dante—Review of argument for latent vitality—Its unscientific character—Scripture view—The student of science not entitled to ignore the testimony of Scripture—Sir Charles Lyell—Mr. Darwin—Vague theories—Recent objections not original—Ancient physcists—Quotation from Jeremy Taylor—Spermatic virtue—Illustration of Psalm xix.—Biblical references to light—Spectrum analysis—Remarkable results—Darkness—Illustration of Isa. xlv. 7; Job xxxviii. 19, 20; Matt. vi. 23; and Luke xi. 23.

THE preceding references to the soil, the plant, and the animal, when regarded from the highest point of view, show us, among many other things, the following series of admirable adaptations :—1st, That the chemical constituents of the soil had their distinctive character given to them for the purpose of supporting vegetation. 2nd, That the vegetation thus supported has ever found its highest purpose and use in yielding support to animals. And 3rd, That the lower animals attain to their highest use, to the expression of the Divine purpose regarding them, when they are pressed into the service of man. Now, it is extremely doubtful if the survey of any other field of inquiry could furnish so many, and so variedly interesting testimonies to the creative forethought, the Divine control and ceaseless

superintending care of the great Creator, as that which has been thus passed in rapid review.

It would not, however, be wonderful, it need not greatly surprise students of the Word and of the world, if men were to enter these spheres of investigation, holding earnestly, along with much knowledge of these and related phenomena, that we may be, and indeed are, mistaken, in associating these fitnesses with the action of an all-wise and an almighty Will. One of the almost inevitable consequences of devotion to certain favourite pursuits, is their tendency to occupy the whole mind, and to blind the student to all above and beyond them. Hence arises a strong inclination to find the explanation of phenomena in relations which are only results of the same laws as the phenomena themselves, and insufficient to do more than bear testimony to their existence, without rising higher; without suggesting the working of a present personal will to account for appearances, and as originating and controlling the forces which lead to them.

One fruit of this state of mind must have often pressed itself on our notice. The novelty of new discoveries is claimed for facts long known to all; theories, with which the world had been familiar for centuries, come to be stated as if nobody had ever heard of them before. That their authors get a hearing, is a proof that in many things each generation starts on its course, in comparative ignorance of the experience of the preceding one. Self-love is thus often saved the humiliation implied in the discovery, that our new truths were well known long ago. But this satisfaction is itself the result of corresponding habits of thought. The garments are

made to look new by slight alterations in the fashion, and speculations, long believed to be dead, are brought out in a new guise, to do their work once more in leading needy, hunger-stricken souls away from the truth itself, and from that healthful influence which comes to us all in the belief of the presence of an ever-working, personal, God.

We are led into these remarks by the most recent attempt which has been made to remove the idea of the presence of a Creator from the domain of science, and to give wider currency to the old prejudice that he is most to be accredited with impartiality, discrimination, and steadiness of observation, who can most completely emancipate himself from the thought that *God*, and not *Law* only, reigns over all. What shape do the phenomena of organic nature assume when looked at, searched into, tried to be explained from, this point of view? Take the following extracts from a paper published recently on Vitality:—

“The origin, growth, and energies of living things are subjects which have always engaged the attention of thinking men. In endeavouring to account for them a special agent was assumed which was, to a great extent, free from the limitations observed among the powers of inorganic nature. This agent was called the *vital force*; and, under its influence, plants and animals were supposed to collect their materials and to assume determinate forms. Within the last twenty years, however, our ideas of vital processes have undergone profound modifications; and the interest, and even disquietude, which the change has excited in some minds, are amply evidenced by the discussions and protests which are now common regarding the phenomena of

vitality. In tracing out these phenomena through all their modifications the most advanced philosophers of the present day declare that they ultimately arrive at a single source of power, from which all vital energy is derived ; and the disquieting circumstance is that this source is not the direct fiat of a supernatural agent, but a reservoir of what, if we do not accept the creed of Zoroaster, must be regarded as *inorganic* force. In short, it is considered as proved that all the energy which we derive from plants and animals is drawn from the sun.

“ Besides the mechanical actions which he produces in the surrounding planetary system, the sun acts as a *radiant* body from which issues, in the form of minute waves, a power whose functions have but recently been fully apprehended. These waves, impinging upon the optic nerve, produce light, and impinging upon other nerves produce heat, the impressions of heat and light depending on our organisation, different parts of which are affected differently by the self-same thing. But the function of the sun is not only to illuminate and warm us ; for, without his vibrations, vegetable life—and consequently animal life, which depends ultimately on that of vegetables—could have no existence. A few years ago, when the sun was affirmed to be the source of life, nine out of ten of those who are alarmed by the form which this assertion has latterly assumed would have assented, in a general way, to its correctness. Their assent, however, was more poetical than scientific, and they were by no means prepared to see a rigid mechanical signification attached to their words. This, however, is the peculiarity of modern conclusions: that there is no *creative* energy whatever in the vege-

table or animal organism, but that all the power which we develop by the combustion of wood or coal, as well as that which we obtain from the muscles of men and animals, has been produced at the sun's expense."

Again:

"If, then, solar light and heat can be produced by the impact of dead matter, and if from the light and heat thus produced we can derive the energies which we have been accustomed to call *vital*, it indubitably follows that vital energy may have a purely mechanical origin.

"In the case of vital phenomena, the source of power consists in the forcible separation of the atoms of chemical compounds by the sun; of the carbon and hydrogen, for example, of the carbonic acid and water diffused throughout the atmosphere, from the oxygen with which they are combined. This separation is effected in the leaves of plants by solar energy. The constituents of the carbonic acid and water are thus torn asunder in spite of their mutual attraction, the carbon and hydrogen are stored up in the wood, and the oxygen is set free in the air. The building up of the vegetable, then, is effected by the sun, through the reduction of chemical compounds. *All the phenomena of animal life are more or less complicated reversals of these processes of reduction.* We eat the vegetable, and we breathe the oxygen in the air, and in our bodies the oxygen which had been *lifted* from the carbon and hydrogen by the action of the sun, again falls towards them, producing animal heat and developing animal forms."

Once more—

"It is generally supposed that our earth once belonged to the sun, from which it was detached in a

molten condition. Hence arises the question, 'Did that incandescent world contain latent within itself the elements of life?' Or, supposing a planet carved from our present sun, and set spinning round him at the distance of our earth, would one of the consequences of its refrigeration be the development of organic forms? *Structural* forces certainly lie latent in the molten mass, whether or not those forces reach to the extent of forming a plant or an animal. All the marvels of crystalline force, all those wonderful branching frost-ferns which cover our window-panes on a winter morning—the exquisite molecular architecture which is now known to belong to the ice of our frozen lakes—all this 'constructiveness' lies latent in an amorphous drop of water, and comes into play when the water is sufficiently cooled. And who will set limits to the possible play of molecular forces in the cooling of a planet?

"In discussing these questions it is impossible to avoid taking side-glances at the phenomena of intellect and will. Are *they*, by natural evolution, capable of being developed from incandescent matter? Whether they are or not, we do not seem to possess the rudiments of an organ which could enable us to comprehend the change; we are utterly incompetent to take the step from the phenomena of physics to those of consciousness. And, even granting the validity of the above explanation, the questions still remain, 'Who or what made the sun and gave his rays such power? Who or what bestowed upon the ultimate particles of matter the forces whose interaction, combined with the energy of the solar rays, produces plants and animals?' Science does not know: the mystery, though pushed back, remains as deep as ever."

Most impotent conclusion ! You start topics which shake old beliefs, or you raise them with the intent of doing so ; you set me questioning about the origin of all, and when, to save myself from the terrible grasp of downright materialism, I push the inquiries further, in the hope of meeting the clear proofs of the working of One whose thoughts shall meet mine, whose affections shall answer to mine, you leave me in the very heart of the dismal darkness ; you offer me only blank, black despair. “ Science does not know : the mystery remains as deep as ever ! ” I ask for bread, and you give me a stone ! Yet how many sincere seekers after truth have had this bitter experience ! No wonder that, in the fire of their disquietude, and in the unrest of their earnest, questioning dispositions, so many should have broken away from that control, which the thought of the presence of a personal Creator near them in his works of creation and providence, really has over men. And no wonder if those thus once left in the dark, but recovered from it by Him who came “ to seek that which was lost,” should look back with trembling on the past, and long that others may be kept from such experiences. How many might use the noble words of Dante, and yet how few, alas ! compared with those who could not :—

“ In midway of this our mortal life
I found one in a gloomy wood astray,
Gone from the path direct ; and e’en to tell,
It were no easy task, how savage wild
That forest, how robust and rough its growth,
Which to remember only, my dismay
Renews, in bitterness not far from death.”

“ Science does not know ; the mystery, though pushed back, remains as deep as ever ! ” Now, let us not give

the go-by to the very weighty questions suggested by these extracts. Especially let us understand the true attitude of science when shut up to such an acknowledgment as that now quoted—an acknowledgment which must be wrung from her most devoted students at ten thousand different points as well as here.

I. This mode of concluding remarks like these is not worthy of science, is, in a word, a departure from the true methods of scientific investigation. Suppose, to take an illustration from zoological classification, we should enter on the study of the lowest group of animals—the sub-kingdom *Protozoa*—taking the edition of the “*Systema Naturæ*” of 1766 as our guide. The first step brings us to the Linnæan, Class VI. (VERMES), over which we notice the haze still hanging. We pass on in our survey of *Intestina*, *Mollusca*, *Testacea*, and uncertainty increases. In *Lithophyta* and *Zoophyta* we find ourselves on the edge of the darkness. We look out on it, but no light breaks on the horizon. Another step and we find ourselves in the midst of that group which the great Swede, in the childlike humility which is the ornament of true science, named *Chaos*. Arrived at this point should we, at this time of day, with the works of Otto Friedrich Müller, Lamarek, Cuvier, Ehrenberg, Dujardin, Milne Edwards, Owen, and Huxley, before us, be entitled to say, in answer to the very questions which Linnæus put,—“Science does not know; the mystery, though pushed back, remains as deep as ever”? Is it not the duty of the student of science to consult every record, to look into every work in which *any* sort of light is shed on the forms of life which he is investigating? And should there be a book claiming to have perfect information on the sub-

ject, would it not be both our duty and our privilege to consult it, to study it with unbiassed attention, yea, to test by every fair method the claims of its author to belief, to respect, to that homage which generous natures ever readily accord to truth? Now on this very topic on which we are asked to believe, that the light shed down is not from man's imperfect knowledge, but from full-orbed truth, from science walking on her own lofty eminence, we have a book, making claim to perfect knowledge; and every student of science is bound to turn to it when he reaches a point beyond which he cannot go. We have the Bible, with its record of creation, with its account of the order of present things, and with its clearly expressed utterances on the origin of all. Not, indeed, as an authority in science—let us ever guard against even appearing to set it up as an arbiter, where it claims for itself no such office—but yet an authority to appeal to at points which science cannot settle, but which science must ever have before it; points at which the Bible reveals facts, in order that it may carry the instruction into her own sphere, and instil the knowledge among her own truths.

Nor let it be imagined, that this reference to the Scriptures is made in any other spirit, or from any other point of view, than such as are in complete harmony with true science, and with true methods of scientific investigation and research. The longer we work in this field, the closer we watch phenomena, and the larger the survey of any one department, the more anxious we are to show that all workers in these fields have strong claims on our sympathies and forbearance. It is a great mistake to suppose that the word of God narrows the work of creation to a point, to

a period of a few days, or even that everything was called into existence in a perfect form. It would not detract from the glory of the Creator if we discovered that the first form of this earth was a nebulous mass, which, as the ages rolled past, assumed the form of incandescent matter, and in time became encrusted. In the first grand step upwards to the present earth we can see miraculous power, direct control of a personal God, as clearly in this as we could in the instantaneous creation of the earth and all that is in it. We would thus leave theorists at perfect liberty, so long as their speculations do not jar on our deepest and most momentous beliefs. These beliefs are from God, equally with those works of his hands with which science specially has to do.

When, then, this claim in behalf of latent vitality in matter, of mechanical force as a life-originating power, is made, it was the duty of the author of the theory to inquire, if there was a different account, alleged to be infallible, of the very phenomena to which he appeals. This, to say the least, were only fair when the book referred to is known to be the only one which lays claim to infallibility on this great question. "Science does not know;" but this book professes to tell us, and its utterance is directly, broadly, most distinctly, a flat contradiction of such views as those now alluded to. Now, it will not do for any observer to say, "I have nothing to do with the Bible," for *he has to do with it on all the points in his studies on which it contains information*; and he must first deal with its value as an authority before he can fairly, honestly, manfully, and in the spirit of true science, set it aside. None of us imagine that the Bible was ever designed to teach geography;

but would any sane geographer fix the site of Hebron, or of Bethel, or of Ramah, from an independent point of view, and refuse to take the Bible references into account, because he might think them directly opposed to his opinions? So of a hundred other topics. Now, what we have a right to claim from all who deal with questions on which the Bible has given a distinct utterance is, that they should weigh the force and full value of this, whether they are willing or no to admit that it should have any authority over their lives. Had the question been simply one, for example, of the scientific difference between the plant and the animal, or of the mode in which animal life is sustained under the ministry of associated forms, or, indeed, any question within the true sphere and province of science, it would have been a plain absurdity to demand a reference to Scripture. But when the question is one which, in its very nature, is beyond the reach of science, and must be settled by a reference to the Creator's testimony to his own works, then we are bound to consider this testimony. We are entitled to say to such theorists, "You claim to enlighten us on the origin of all. Deal with the Scripture account. Set it aside first, and then we will give heed to your theory—a theory whose scope, we fear, is 'like lime-twigs set to catch my winged soul.'"

II. The mode in which it is attempted to pledge us to the erroneous views expressed in the preceding extract should be noticed. In adverting to these we are anxious not to make more of them than is warranted; because, if anywhere, it is especially the case in science, that to exaggerate the effect of any hypothesis, is to miss its scope, and to deal unfairly by its author.

But all science, worthy the name, seeks truth. Like the charity of which the apostle writes, "it seeketh not its own." Now, principles are hinted at here which, if followed out, would land us in a materialism, deeper, darker, more hopeless than our fathers ever heard of. These, moreover, are set forth in quarters more influential on British thought than almost any others; and we venture to say, that in a few years the views now noticed will have called forth kindly echoes from a numerous class, who, unable to indulge in such speculations for themselves, will gladly welcome them as seeming to put God farther away, than from their point of view, he now seems to be.

Besides, statements like these coming from such quarters are fairly in the teeth of all those inductions, on a scientific basis, touching the order of nature, the adjustments of creation, the adaptations between means and ends, and the evidences of different aspects of plan in the organic kingdoms, to which the student of natural theology has ever loved to turn, and of which he has made so much use. They must thus be looked in the face closely, and, if possible, removed out of the way.

Let us put, as strongly as possible, the present state of the question. When, many years ago, Sir Charles Lyell brought his great abilities to illustrate what is known, in geology, as the theory of the continuous and quiet action of natural law, one of the strongest arguments against it was the repeated evidences of breaks in the geologic series of rocks, connected with the introduction of new forms of animal life and of vegetation. Is there not, it was argued, a very strong presumption that these breaks in the suc-

cession of life were contemporaneous with breaks in the superposition of rocks? Lamarck's theory of development did not afford a good standing ground on which to meet this, because while the transition from one well-worked group of strata to another could be detected, no such links in the so-called "chain of being" could be found. Accordingly, Sir Charles Lyell did more than perhaps any other British worker in science to cast ridicule on, to damage, if not to destroy, the Lamarckian hypothesis. He saw clearly that the loss of so many of the highest forms of animal life and of vegetation, with which as a geologist he was familiar, was wholly against this theory. But when Mr. Darwin came forward with his apparently formidable array of alleged facts, all held to bear witness to the destruction of numberless forms by forces which had ever worked as quietly as the natural laws of his geologic hypothesis, Sir Charles could not help stretching out a ready hand of welcome. This was just what his theory needed. Thus Mr. Darwin's theory as to the Origin of Species, fitted exactly into Sir Charles Lyell's theory touching the uniform action of natural law in geologic periods of the earth's history. In both cases, if a Creator was acknowledged at all, he was pushed so far out of sight, he was thrust so far away from his own works, he was banished into such a remote corner of his own dominions, that neither his presence nor his power were much thought of. His being was not denied or called in question. That he might be, was indeed accorded. What he might be, what he has been, what he is, were questions in which the theorists were as little interested as the unlettered peasant is in Newton's "*Principia*," or in the latest treatise on the differential

calculus. Yet there is no denying, that even the sense of the presence of a personal God in the world, the dim and shadowy, though remote indications of the Creator, exercised a disturbing influence. Could there not be creation by law, as well as manifestation by law? Could not the ever-working forces be dissociated from a personal will, and be found to act in virtue of inherent vital power? To the illustration of an hypothesis which implies all this, and much which lies deeper down in the dark ignorance of the real and the true, the author now in view has given himself. The theory of inorganic force, of latent vitality in matter, is the only other element which that of Sir Charles Lyell needed. It may now be held to have received the coping-stone. Thus, inorganic force having been made an originating, a creating power, the physical history of the globe becomes only one great commentary on its constant working, and the whole world of animals and plants are regarded as simply the products of a mindless influence. Thus, again, "the black finger" in Richter's dream "points, and the dead seek to see by it."

In looking somewhat more closely at these views, it will at once be seen how vague and uncertain some of the statements are, and yet how skilfully they have been framed. We are, indeed, far from averring that their author was under the power of any long-cherished dislike of truths most generally believed by men. The words, however, bear the construction now put on them.

The old belief that the organs of plants were only the channels through which vital force acted, and not the force itself, is here said to be wrong. The force and the organism are one and the same. Both have been derived from the sun. You might, with far more propriety, say that the iron of the steam-engine is

identical with the steam which works on it and by it, or that the houses in which we dwell differ in nothing but arrangement from the minds of those inhabiting them. Indeed, matters are carried thus far, for it is suggested that every mind may have precisely the same nature as the body in which it is lodged, and which it was previously held only to animate.

No wonder that such views should have led to disquietude. "Philosophers of the present day," we are told, "declare that they ultimately arrive at a single source of power, from which all vital energy is derived, and the disquieting circumstance is, that this source is not the direct fiat of a supernatural agent, but a reservoir of what must be regarded as inorganic force." Disquietude thus arises among those who had been in the habit of tracing all to a supernatural source—to a Creator, to God. But take this on the writer's own ground. You say that the sun is the source of vital force. We have a history which takes us back over thousands of years, yet it records to us no fruits of the sun's creative energy, but innumerable proofs that the sun is used in supporting organisms already in existence. During these thousands of years no new path has been struck out, no new forms realised, no hints even that the sun is about to add to the variety of its works, and introduce a race which shall be more ready to receive this kind of speculation as if it were science, than the truth-seekers of the present generation are. But, suppose we should push the question further. The sun is a source of power—Is the power eternal? If not, whence came it? It underlies phenomena, and we trace these to its working; but the question still arises, Whence came it? Are we answered when we are told that "solar light and heat can be produced by the impact of dead matter"?

Whence the matter which, in different masses, shall meet in such terrible collision as to educe a world of light and heat? But "the sun acts as a radiant body, from which issues, in the form of minute waves, a power whose functions have but recently been fully apprehended. These waves, impinging on the optic nerve, produce light, and impinging on the other nerves produce heat." Was there ever such an artificer? He first makes the nerves, and then he produces heat and light by his waves "impinging on the nerves." And yet "there is no creative energy in the animal and vegetable." If by this oracular statement it is meant, that neither the animal nor the vegetable have power to create, we all knew that before; but if it be meant that they have not been created, then how came they to be?

But it is generally supposed that the earth once belonged to the sun, from which it was detached in a molten condition. Hence arises the question—"Did that incandescent world contain, latent within itself, the elements of life?" If the life was latent in the earth, it must have been so in the sun; but that life is only a fruit of inorganic force. Here, according to this philosophy, we meet with one eternal entity, inorganic force. But enough on these points. It is, surely, not necessary to point out how very little weight is to be attached to the query in regard to man's spiritual nature, his intellect and will—"Are they capable of being developed by evolution from incandescent matter?"

III. The views thus submitted to us, with such a show of freshness, have not even the dubious merit of certain being original. In referring to this, we shall notice speculations of great beauty mixed up with them by other authors. If we consult Ritter's "*Geschichte*

der Philosophie," or Lewes's "Biographical History of Philosophy," we shall find a good summary of the philosophy of the ancient physicists. On the threshold we meet a statement of the doctrine of Thales (B.C. 636)—"Seeing around him constant transformations,—birth and death, change of shape, of size, and of mode of existence—he could not regard these variable states of existence as existence itself. He therefore asked himself the question, What is that invariable existence of which there are variable states? In a word, What is the beginning of things? He looked around him, and the result of his meditation was the conviction that Moisture was the Beginning." "He found moisture everywhere. All things he found nourished by moisture; warmth itself he declared to proceed from moisture; moisture the seed of all things." Here was the deification of water. This element was soon seen to be equal to all things. Water condensed became solid, and was supposed to be met with in this condition in the rock crystal. The decay of this, under the influence of surrounding moisture, becomes earth. Thus he could, from his point of view, name facts in proof as strong as those of the theorist to whom we have referred. He clearly got hold of the idea which is here made so much of, that nature should be able to explain the alleged mystery of its own existence.

Then came Anaximenes (B.C. 548). "Water was not to him the most significant element. He felt within him a something which moved him, he knew not why; something higher than himself; invisible, but ever-present. This he called life. His life he believed to be air." The air was thus the beginning of things. "He looked around him, and thought his conjecture

confirmed. The air seemed universal; the earth was as a broad leaf resting upon it. All things were produced from it; all things were resolved into it." "Air breathed and expired seemed the very stream of life, holding together all the heterogeneous substances of which the body is composed, giving them not only unity, but force, vitality."

Here we have the very ring of the words used by the modern physicist. After Anaximenes came Diogenes of Apollonia (B.C. 460). "Adopting the tenet of Anaximenes, he gave a wider and a deeper signification to it by attaching himself more to its analogy with the soul. Struck with the force of this analogy, he was led to push the conclusion to its ultimate limits." "What constitutes air the origin of things? Clearly it is vital force. The air is a soul; therefore it is living and intelligent. But this force or intelligence is a higher thing than the air through which it manifests itself; it must consequently be prior in point of time; it must be the ἀρχή philosophers have sought. The universe is a living being spontaneously evolving itself, deriving its transparencies from its own vitality." The stars were regarded by him as the respiratory organs of the world. All creation, and all material action were but respiration and exhalation.

This will show that the views to which our attention have been called are not original. They were expounded, and attracted a listening company more than two thousand years ago. Nor can we withhold our sympathy from these men—

"Yearning in desire
To follow knowledge, like a sinking star,
Beyond the utmost bound of human thought."

They could do nothing but grope after the Author of all, striving in suffering, and under the burden of weariness, to attain unto the knowledge of Him or It; felt to be above and beyond them. Anxious to break through the mystery which enveloped them, but with like success, as the child who tries to grapple with the darkness, what wonder if their highest attainments should now provoke a smile, and their profoundest theorising seem but as foam floating on the deep waters of modern Christianised thought? But to be taken back to their point of view by a leader—a leader, even, of most varied accomplishments—is something like an insult thrown in the face of those who love truth, and know that all truth is associated with the person of Him who is “the true God and eternal life.”

If the author of this hypothesis has borrowed from the ancients, and said nothing about it, he has been even more indebted to some moderns, without acknowledging that the beauty which he has so blurred by putting it in false, coloured lights, is not of his own discovery, nor of his setting. Such as are acquainted with the singularly attractive letters of Liebig on Chemistry will see the justice and fairness of this statement. In another work, much less known, the phenomena of air and of light are set even more beautifully before us. I mean “The Chemical and Physiological Balance,” by MM. Dumas and Bousingault (1844). An extract from this little work will show on what borrowed bases original (?) speculations often rest. Having described those remarkable interactions, that constant interplay of influence and relations between the atmosphere, the plant, and the animal, to which we have already referred, they say, “Thus is the mys-

terious cycle of organic life upon the surface of the globe completed and maintained. The air contains or engenders the oxydized substances required—carbonic acid, water, nitric acid, and ammonia. Vegetables—true-reducing apparatus—seize upon the radicles of these, carbon, hydrogen, azote, ammonium, and with them they fashion all the variety of organic and organisable matters, which they supply to animals. Animals, again, true apparatus of combustion, reproduce from them carbonic acid, water, oxide of ammonium, and azotic or nitric acid, which return to the air to reproduce the same phenomena to the end of time. And if to this picture, already so striking by its simplicity and grandeur, we add the indubitable part performed by the solar light, which is alone possessed of power to bring into play this immense, this unparalleled apparatus constituted by the visible kingdom in which the oxydized products of the atmosphere are subjected to reduction, it is impossible not to be struck with the import of these words of Lavoisier: ‘Organisation, sensation, voluntary motion, life, only exist on the surface of the earth, and in places exposed to the light.’ It might, indeed, be said that the fable of Prometheus was the expression of a philosophical truth which had not escaped the penetration of the ancients. Without light, nature were without life, and without a soul. A beneficent God, in shedding light over creation, strewed the surface of the earth with organisation, with sensation, with thought.” Who can doubt that this is the very view of our theorist, set before us with more beauty, and *plus* the acknowledgment of a personal, beneficent God!

There is the greater need for our being well informed on such topics as those now referred to, because of the great and increasingly prevalent confusion of thought

in regard to them ; and all the more so, that they have come to influence not the physicists only, but the naturalists also. A short time ago Professor Huxley published a volume on the "Elements of Comparative Anatomy," in which this statement occurs when characterising a very low form of life—the *Gregarina*, met with as parasitic in the intestinal canal of the common earth-worm :—" It seems difficult to imagine a state of organisation lower than that of *Gregarinida*, and yet many of the *Rhizopoda* are still simpler. Nor is there any group of the animal kingdom which more admirably illustrates a very well-founded doctrine, that life is the cause and not the consequence of organisation." The remark is, when regarded by itself, perfectly true ; but, when taken in the light of a previous statement, its edge is at once blunted, its point broken off. " It is possible and conceivable," he says, " that every animal should have been constructed on a plan of its own, having no resemblance whatever to the plan of any other animal. For any reason we can discover to the contrary, *that combination of natural forces which we term life* might have resulted from, or been manifested by a series of infinitely diverse structures." " That combination of natural forces which we call life." Organisation, then, results from a combination of natural forces—is caused by it—is the fruit of its working—for *it* is life. What the forces are, and what the mode of combination—whether under law or by haphazard—we are left to guess.

Before leaving this subject, let us call to mind the singularly beautiful use which Jeremy Taylor has made of those views of the ministry of the heavens, which were floating in the minds of the thoughtful in his day, and on which recent science has shed so much light.

His words will lead us back again to the point of view characteristic of our present inquiries, which the sharp and somewhat angular utterances of the controversial spirit so often unavoidably disturb. "To sum up all," he says, in his sermon on "The Christian's Conquest over the Body of Sin," "every good man is a new creature, and Christianity is not so much a Divine institution as a Divine frame and temper of spirit, which, if we heartily pray for and endeavour to obtain, we shall find it as hard and uneasy to sin against God as we now think it impossible to abstain from our most pleasing sins. For as it is in the spermatic virtue of the heavens, which diffuses itself universally on all sublunary bodies, and subtilely insinuating itself into the most dull and inactive element, produces gold and pearls, life and motion, and brisk activities in all things that can receive the influence and heavenly blessing, so it is in the Holy Spirit of God, and the word of God, and the grace of God, which St. John calls 'the seed of God ;' it is a law of righteousness, and it is a law of the spirit of life, and changes nature into grace, and dulness into zeal, and fear into love, and sinful habits into innocence, and passes from grace to grace, till we arrive at the full measure of the stature of Christ, and into the perfect liberty of the sons of God." Yes! this is the highest use to which any of us can turn our knowledge of the ministry of the heavens, and our acquaintance with its fruits beheld in the phenomena of nature. Thus shall we be led into His presence whom it is our highest privilege to know in order to love, and to love in order to serve.

This reference to the "spermatic virtue" of the heavens, to illustrate the prevailing and ever-acting

virtue of the seed of God, is very beautiful. It is, however, as true as it is beautiful. An illustration of its truthfulness, which the eloquent preacher had not in his view, will now occur to most. It is in the line of our present remarks, and may be glanced at in passing. We refer to Psalm xix. When we appeal to the ministry of the heavens as a ministry of blessing and life to living beings, let us ever hasten to set this in its highest relations—even in those in which the Creator himself has set it. Whilst men turn their faces to the sun, with feelings akin to the early disciples of Zoroaster, and their backs on Him who set the sun in the heavens, let us show that his children have ever been ready to acknowledge, that in no other part of cosmical arrangement is the glory of the Creator brighter. If the doctrine of latent light and heat is sought to be established by the aid of modern physical hypotheses, now so loudly vaunted, let us not fail to suggest (without accrediting the Hebrew sage with a knowledge of facts which is peculiar to recent science) that He who has covered himself with light as with a robe, and who dwells in it as in a temple, so guided the devout meditations of his servants, that they should ever answer to advancing knowledge.

“The heavens declare the glory of God;
And the firmament showeth his handy work.
Day unto day uttereth speech,
Night unto night showeth knowledge.”

What force! what significance in the very language! “Uttereth”—literally, maketh to gush forth as waters from a pent-up spring. He who had dwelt from everlasting in his own ineffable bliss, uncreated, independent, eternally glorious, calls the world into

existence, sets his throne on the riches of his own universe, and from the heart of time—day and night—out gushes the deep, though inarticulate testimony to the glory of its Creator ! You stand before one of those great pictures, in whose unfading colours genius has told some world-famous historic tale. The grouping of the figures, their colouring, the delicate handling of the least details strike you at once, and you pay well-deserved homage to him whose mind conceived, and whose cunning hand realised the whole. “Speech” were useless ; “voice” would but mar the enjoyment. The greatness of the painter bursts forth in every part. And this is the highest testimony to the genius of the artist. Such is the testimony uttered by God’s works to God. “There is no speech nor language. Their voice is not heard”—but their testimony is all the more powerful on this account.

“Their sound is gone through all the earth,
And their signs to the end of the world.”

I say “sound” and “signs,” for such is the true rendering. In the one case reference is made to a musical instrument; we have this music without words, a hymn from the heart of creation in praise of its Creator. And, in the other case, to a sign indicative of the glory of him to whom it points. “In Reason’s ear they all rejoice.” If we stand amidst creation as worshippers we shall be able to hear with the heart what “day says to day” of this glory, and what “night says to night.”

But whence this testimony from the heavens ? It is because God has set the sun in them. And, thus set, he is looked to as the source of “light and heat.” “Light,” or manifestation, “heat,” or influence, being

the terms expressive of the twofold ministry. Circling in the heavens, all men see his brightness—streaming down on the earth, every living thing acknowledges his power. See the results useful in the highest degree! “He gives us fruitful seasons, filling our hearts with gladness.” But David had yet another end in view in this reference—an end which, in true keeping with the thought throughout, is only hinted at here, but is plainly stated by David’s Lord—“That ye may be the children of your Father which is in heaven; for he maketh his sun to rise on the evil and on the good, and sendeth rain on the just and on the unjust.”

Here then is the point—the formal exegesis of the symbols among which he has been walking. What the sun is in the natural, that the word of God, the revelation of God, is in the moral world. “Light,” in opening to us the knowledge of the Father; “heat,” in influencing our whole spiritual nature—yea, in so pervading it and assimilating it to its own nature, that the very judgments of God themselves were “more to be desired than gold, and sweeter than honey from the comb.” What more can be sought for but a sense of dependence? This is given, and shows itself in the cry of prayer, “Cleanse Thou me from secret faults.” “Thy pervading, penetrating, sunlike light shows me the sins that lie far out of sight, or suggests that they are present; thy powerfully influential heat goes into my heart of hearts, and hastens to make me find my all in Thee, O Lord, my strength and my Redeemer.” Is not the ministry of the heavens worth noting, then?

Now the immediate agent in this ministry, is just that

light, to which, some, going back to the point of view of primitive theism when it began to fall from its high position and to ascribe divinity to the works of God, are at present bent on making equal to the production of all vitality, and consequently of all thought and all will. It would then mar the completeness of our review were we not to linger for a few minutes around this subject, and try to ascertain what the scriptural views of it are. This investigation may perhaps open up to us aspects of the question even more interesting than those already referred to; as honouring to God and as worthy of those who wait on him as the others are dishonouring to God and unworthy of man himself.

As in other cases, so here, the key-verse to the understanding of many verses, more or less closely related, is to be found in the latest-written books of Scripture. We take James i. 17, as our starting point, where God is said to be *πατὴρ τῶν φῶτων*—"the father of lights." Going back more than 700 years in the history of the church, we meet with an expression which sets this before us in another aspect. "I am the light," literally, "I forming the light," "I Jehovah." It is an unceasing manifestation of his power—power first shown in the original calling forth of light. God said, "Let there be light, and there was light." Here, once more, the physicist hastens to explain phenomena, and urges a cosmical theory to illustrate the origin of light, and the origin of worlds formed from the light. Thus we have the rotating fire-mist of irregular density, supposed by La Place to be the beginning of all the worlds in our system. "In condensing by cold, this leaves, in the plane of the equator, zones of vapour which must have commenced circulating round

the sun, the central point, in the form of concentric rings like those of Saturn. These ultimately break, and the separate portions continue in the same orbit:"—and thus and thus, world on world. It has already been stated, that there can be no objection to this theory, if it be acknowledged that a divine and omnipotent One called the mist into existence, and who, having given it this law, watched over the development of the worlds up to this present order of things. It would satisfy even a highly poetical imagination to find that this world, and the solar system as a whole, had originated in a spark struck off from that "light inaccessible" in which "the Father of lights" dwells.

But we tread on safer ground in gathering up the Biblical references to this element. Safer, yet not less beautiful. Created light keeps its place in the world, either latent, as in ten thousand kinds of matter, if not in all, serving highest ends in the great system of creation, or forming the glorious atmosphere of the sun itself, from which it streams to the earth for highest ends—ends, too, which even a professed atheist could not help admiring. "Look," says Shelley—

"Look at yonder earth:

The golden harvests spring; the unfailing sun
Sheds light and life; the fruits, the flowers, the trees,
Arise in due succession; all things speak
Peace, harmony, and love."

It remained that one should be created who could enjoy the light, thus shed into and over all things by the Source and Lord of all. "God created man." "The seeing eye the Lord hath made" (Proverbs xx. 12). "The light of the body is the eye" (Matt. vi. 22). And

man has entered into the Divine purpose—"Truly the light is sweet, and a pleasant thing it is for the eyes to behold the sun" (Eccles. xi. 7). Its moral bearings now begin to appear: "The light of the eyes rejoiceth the heart" (Prov. xv. 30). Now we need only fall back on the testimony of science to the wonders of Divine mechanism in the eye thus prepared for the light, to feel that God so formed it that man might rise into sympathy with Him, "the Father of light." "God saw the light that it was good," is the word expressing the Divine estimate of it. "Truly light is sweet," is the word which testifies that in this the Christian man has risen to his privileges, and regards the light as God did.

But having reached this point in regarding light as God's creature, we now come to the brink of yet higher bearings,—bearings suggestive of most beautiful, and yet most weighty analogies. And first, notice how man is again brought up to the Creator's point of view. One of his inspired servants is led in the spirit out into the wide field of nature. He observes and records his observations of the phenomena of clouds, and winds, and rain, of calm and storm in air and ocean, of the lightning's flash and of the rolling thunder, of mountain and valley, of river and spring, of the grass for cattle, of the herb for man, of corn and wine, of beast and bird, and of innumerable creeping things. After all this he returns to meditate on the treasures which the seeing eye had brought home to the enlightened mind and heart. He had gained the true standing ground; he had reached the true point of view; and in the face of all he had seen, his heart was touched, and thus rose up his hymn:—

“Bless the Lord, O my soul.
O Lord my God, thou art very great;
Thou art clothed with honour and majesty.
Who coverest thyself with light as with a garment.”

The observation of the same phenomena by those who had no true knowledge of God, and thus knew not of that victory over themselves which is above nature, and which helps us to take nature into the presence of God, degraded the light by offering worship to the host of heaven, a homage which was the first gross idolatry into which men fell. Degrading as this was, it was not, however, far less so than “the changing of the glory of God into an image made like to corruptible man, and to birds, and four-footed beasts, and creeping things.”

“Thou coverest thyself with light as with a garment.” Jehovah accepted the testimony, and in doing so invited to yet closer application of these figures. “God is light, and in him is no darkness at all,” says St. John, that he might make to us all this appeal,—“If we say that we have fellowship with him, and walk in darkness, we lie, and do not the truth.” Truth-doing is walking in the light. But how are we with our darkness thus to walk? The answer was ready—“The blood of Jesus Christ, his Son, cleanseth us from all sin;” “us,” truth-doers who walk in the light. What light? “God is light.” “He is the Father of lights.” He is the Father of our Lord Jesus Christ, who is “the Sun of Righteousness,” “the Light of the World,” “the true Light.” And all brought to him can say, “The Lord is my light and salvation,” or can pray, “Lord, lift up the light of thy countenance upon me.” Thus we get back again to the nineteenth

Psalm. The tabernacle for the sun, which he set in the heavens, supplies the typical analogy of another which is hinted at in the opening of John's Gospel, *ὁ λόγος σὰρξ ἐγένετο καὶ ἐσκήνωσεν ἐν ἡμῖν*—"tabernacled among us," in that visible firmament through which the angel was seen flying, having "the everlasting gospel to preach unto them that dwell on the earth."

In this line of remark, this attempt to trace these analogies, we are not pushing the words of Scripture beyond their true scope; we are not applying to them barren principles of accommodation. We see that the Spirit of God himself applies the words in such ways as warrant our views. We can hardly have failed to notice, at how many points numerous facts of science connected with light are suggestive of the very same thoughts as those pointed to by Biblical writers. We can hardly have failed to see, that every reference to light associates it immediately with Him who is the "Father of lights,"—the great Creator. And in this language we have a strong protest against all theories of latent light and heat as the possible source of vitality, which regard it as "not the direct fiat of a supernatural agent, but a reservoir of what must be regarded as inorganic force."

But this subject claims attention from yet another point of view. Advancing science is every day multiplying the number of analogies between the statements of the Bible and the phenomena of nature. Many very recent, but deep and difficult researches into the nature of the spectrum, both of the solar and the electric light, illustrate very fully how important is the service which science may render to Scrip-

ture, by shedding new and unlooked-for meaning on many passages with which we have long been familiar.

If we transmit a ray of light through a triangular prism, it is decomposed in passing, and instead of one whitish streak, we see its seven colours—violet, indigo, blue, green, yellow, orange, red. This is named the “luminous spectrum.” “We are so accustomed to associate the word *ray* with the idea of light, that the term dark, or invisible, or obscure rays, stimulates the imagination by its strangeness. And such is more particularly the case when we are told that the major portion of the radiation of the sun itself is of this invisible character. This great discovery was announced sixty-five years ago by Sir William Herschel. Permitting a sun-beam to pass through a glass prism, he formed a coloured spectrum of solar light; and, carrying a small thermometer through its various colours, he determined their heating power. He found this power to augment gradually from the violet to the red; but he also found, to his surprise, that the calorific action did not terminate where the visible spectrum ended. Placing his thermometer in the dark space beyond the red, he found the heating power there to be greater than in any part of the visible spectrum. Sir William Herschel concluded from his experiments that besides those rays which, acting separately upon the retina, produce the sensation of colour, and the sum of which constitutes our ordinary sunshine, a vast outflow of perfectly invisible rays proceeds from the sun; and that, measured by their heating power, the strength or energy of these invisible rays is greater than that of all the visible rays taken together. This result was questioned by some, and confirmed by others;

but the correctness of Sir William Herschel's announcement was soon completely established. Forty years after the discovery of those invisible rays by his father, Sir John Herschel made them the subject of experiment. He made an arrangement which enabled him to estimate the heating power of the spectrum by its drying power. Wetting by a wash of alcohol, paper blackened on one side, he cast his spectrum on this paper, and observed the chasing away of the moisture by the heat of the rays. His drying paper presented to him a *thermograph* of the spectrum, and showed the heating power to extend far beyond the red.

“By the introduction of the thermo-electric pile, Melloni created a new epoch in researches on radiant heat. This instrument enables us to examine, with a precision unattainable with ordinary thermometers, the distribution of heat in the solar spectrum. Melloni himself devoted some time to this subject. He had made the discovery that various substances, in the highest degree transparent to light, were eminently opaque to those invisible heat-rays. Pure water, for example, is a body of this kind. Only one substance did Melloni find to be equally pervious to the visible and the invisible rays, namely, transparent rock-salt. As in the case of the solar spectrum, the heat was found to augment from the violet to the red, while in the dark space beyond the red it rose to a maximum. The position of the maximum was about as distant from the extreme red in the one direction, as the green of the spectrum in the opposite one.

“Abandoning prisms of glass, which had been always employed previously, Melloni made use of a prism of rock-salt in his experiments on the solar spectrum. He

was thus enabled to prove that the ultra-red rays discovered by Sir William Herschel formed an invisible spectrum at least as long as the visible one. He also found the position of maximum radiant power to lie as far on one side the red as the green light of the spectrum on the other.

“Dr. Franz, of Berlin, subsequently examined the distribution of heat in the solar spectrum, employing for this purpose a flint-glass prism. He showed that the inaction of the ultra-red rays upon the retina did not arise from the absorption of those rays in the humours of the eye; at all events he proved that a sensible portion of the invisible rays was transmitted across the eyeball of an ox, and reached the back of the eye. Professor Müller, of Freiburg, afterwards examined very fully the heat of the solar spectrum; and representing, as Sir William Herschel also had approximately done, by lines of various lengths the thermal intensity at various points, he drew a curve which expressed the calorific action of the entire spectrum.

“At various intervals during the last ten years Professor Tyndall has occupied himself with the invisible radiation of the electric light; and to the distribution of heat in its spectrum he directed attention in a discourse given on the evening of Friday, the 20th of January, 1865, at the Royal Institution. The instruments made use of were the electric lamp of Duboscq and the linear thermo-electric pile of Melloni. The spectrum was formed by means of lenses and prisms of pure rock-salt. It was equal in width to the length of the row of elements forming the pile, and the latter being caused to pass through its various colours in succession, and also to search the space right and left of

the visible spectrum, the heat falling upon it, at every point of its march, was determined by the deflection of an extremely sensitive galvanometer.

“The augmentation of temperature beyond the red in the spectrum of the electric light is sudden and enormous. Representing the thermal intensities by lines of proportional lengths, and erecting these lines as perpendiculars at the places to which they correspond, when we pass beyond the red these perpendiculars suddenly and greatly increase in length, reach a maximum, and then fall somewhat more suddenly on the opposite side of the maximum. When the ends of the perpendiculars are united, the curve beyond the red, representing the obscure radiation, rises in a steep and massive peak, which quite dwarfs by its magnitude the radiation of the luminous portion of the spectrum.”

By a series of delicate arrangements the dark rays have been separated from the luminous ones and experimented on, and it is now established that the spectrum is twofold—dark and light; the dark meeting the light division at the point of highest temperature—namely, the edge of the red colour. From this point it rises till it reaches a distance equal to that between the green and the red in the spectrum.

Bearing these facts in mind, we are in circumstances to associate certain passages of Scripture with them, and to acknowledge that the discoveries referred to illustrate by analogy some well-known Biblical statements. “I form the light, I create darkness,” says the Lord by his prophet (Isa. xlv. 7). Darkness is not always, as we have been accustomed to think, the mere absence of light. Evil is not the mere absence of good; sin is not the mere absence of holiness. These are

all positive qualities. They are real. This is the testimony of the highest science as to the nature of darkness. But with this agrees the witness of the word of God—"I create darkness." From this point of view, the challenge of Jehovah seems grand indeed—"Where is the way where light dwelleth? and as for darkness, where is the place thereof, that thou shouldest take it to the bound thereof, and that thou shouldest know the paths to the house thereof?" (Job xxxviii. 19, 20).

But, perhaps, the most striking passage suggestive of a similar meaning, is that uttered by our Lord himself: "If the light that is in thee be darkness, how great is that darkness" (Matt. vi. 23). Again, "Take heed that the light which is in thee be not darkness" (Luke xi. 35). We now know that there are dark rays in sunlight; that, if we may use the expression, there is light which is dark, and which, when isolated from those luminous rays which temper it and which can make it of the highest use, is both terrible in its effects and destitute of all beauty. It has no element in it which glorifies its Creator habitually before men. It is darkness. But does not the Spirit of God say to all saved by grace, "This was your condition morally—'Ye were sometimes darkness' (Ephes. v. 8); ye had left 'the paths of uprightness to walk in the ways of darkness' (Prov. ii. 13); 'Take heed, therefore, that the light which is in thee be not darkness' " ? It is not indeed alleged that all this was in the mind of Christ when he uttered these words, or that he had a special eye to the analogy pointed to above. We do not know, however, what was in his mind. His mind wandered throughout all his own works, and may have

had the points now noticed fully in view. We venture no farther, warned by Bacon's weighty words. "There are," he says, "those who attempt to fly up to the secrets of the Creator on the waxen wings of sense." Guided by the light which in science shines brightly out, especially for those that love God, we would enter into his presence, but we cannot even then penetrate the secrets of the All-knowing, the mystery of the All-wise. "Lo, these are parts of his ways, but how little a portion is heard of him?"

CHAPTER VI.

GENERAL ADAPTATIONS.

Illustrations from the earth's surface—Influence of these on man's moral nature—Evidences of intention—Moral bearings—Power and phenomena—Personal will in nature—Contour of continents and progress of inhabitants—Relations between them—Illustrations—Coast-line and commerce—Atlantic and Pacific Oceans—The earth made for man—Development theory; mistakes—True point of view—Progress in creation—Hugh Miller's view of development defective—Complication of structure and zoological rank—Importance of geological study to Christians—Natural law—"There was not a man to till the ground"—Knowledge of Adam's immediate descendants—Physical features of original seat of human race, and of Palestine.

I HAVE already referred to certain adaptations on a large scale—a class of fitnesses which have been, perhaps, too much left out of sight, but which are highly fruitful of suggestive materials to the student of natural theology, who looks at them from the point of view that the world was made for man, and that this end was in the mind of the Creator from the beginning. Among others, the fitness of the soil to yield a body to man has been rapidly reviewed. Let us now see if there be any features in the earth's surface, and in the configuration of its great masses, especially fitted for calling out, engaging, and developing the intellectual gifts and the moral qualities of certain great families of mankind. Here we shall have to draw illustrative matter from physical geography—from the geology of the surface chiefly. These subjects

have not received the thoughtful consideration they assuredly deserve.

I. There is what may be called the final cause of creation, on the one hand, and, on the other, the barrenness of natural science, so long as it is separated from the moral world, and pursued apart from those ethical relations implied in the revelation of God in his works. In order to discover the final cause or purpose of creation, we are not limited to the Scriptures. There, no doubt, it is written so clearly that he even who runs may read. But if we deal with any invention in mechanics, if we take a machine of any description, examine it piece by piece, put these in their place again, and consider it as a whole, the first step we make to a just appreciation of it is when we know the intention of its inventor. This may be discovered in one of two ways. It may either be broadly announced by the mechanist himself, or it may be inferred after a close study of the various parts of the machine. The latter is the most interesting method, because it never fails to set us in close sympathy with the inventor, while it brings into lively exercise a class of powers having a strong resemblance to, if not identical with, those which led to the invention. What is gained here? Much more than an intimate acquaintance with the thing itself. There is some knowledge of the mind of the inventor himself. One moral nature is brought into close relation with another. Then we become acquainted with its bearing upon other inventions, with its influence on the social life and industrial arts of a nation, and, in some measure, with a highly complicated moral world, which these deeply affect at many points, and

lightly touch at many more. The invention by itself, separated from the thought of its author, would not interest us much. It could not; for all the points which truly touch one man are the points which stand more or less closely related to the moral nature of other men. If objects are to influence, we must ever have persons in view. The inventor cannot stand alone. No more can his invention. The attempt to make anything stand by itself and for itself, to isolate it and confine to it the aim and end of its own existence, would be to attempt the destruction of moral relations in physical phenomena. But the union between these has existed from the beginning, and will continue to exist. Thus if we leave ethical considerations out of view in our study of creation, we signally fail to study it aright.

We have already seen that the soil was created for the vegetable, the vegetable for the animal, the animal for man, who is himself animal, *plus* spirit—mortal and immortal—the link which lifts nature into the very highest ethical relations; for by him that which is purely physical, purely material, is brought into the presence of God. The natural is associated with the supernatural, and God is seen, acknowledged, and loved as the author and maker of his own world. Man is the link here, and without man nature would thus have fallen far short of its design. Nature is bound together in every part—the organic with the inorganic, molecules with molecules, equally in the body of the earth and in the organisms which people its surface; but a merely physical tie says nothing about God, tells none of the highest truths. Man, doubly endowed man, with animal nature and reasonable soul, plants his foot on

the soil, and the earth in that instant is associated with heaven. He reads its final purpose, the end and aim of the Creator in creation ; and his utterance, equally now with that of the written and infallible word, is that this purpose, end, and aim is the glory of God. His testimony becomes a psalm in honour of his Maker. Thus again, "The heavens declare the glory of God ; and the firmament showeth his handiwork. Day unto day uttereth speech, and night unto night showeth knowledge. There is no speech nor language, where their voice is not heard. Their line is gone out through all the earth, and their words to the end of the world."

This prominence is given to the relational and moral bearings of such considerations, without any formal attempt to analyse the nature of the various steps by which they are reached. It is, however, worth while to linger here for a moment, and to mark carefully and distinctly these steps. Assuming that power lies behind phenomena, and that effects imply an underlying and ever-working causal influence, we can test such assumptions from various points of view. Beginning with that knowledge of ourselves which is obtained by direct and immediate introspection, we rise to the knowledge of intelligent beings beyond ourselves. The connecting link, the step from fundamental self-knowledge to the knowledge of others or of another—being found in our studies day by day, the process implied here is both easy and interesting. I become conscious of a power to will, to think, to love ; but this power, which implies personality, would be hid from all but myself were it not for its manifestations. Will leads to action ; thought, to the employment of certain means to definite ends ; and emotion, feeling, affection, sur-

round endeavour with a moral atmosphere. In my intercourse with men I see fruits of working will, active intelligence, and influential love, similar to those of which my knowledge of myself has made me conscious—a knowledge of whose reality I am so fully persuaded, that I should resent as an insult every attempt to cast doubt on its being true and fundamental. In this discovery, then, I at once conclude that those fruits spring from the action of powers similar to my own—from a person who wills, thinks, and loves. But, in my scientific studies of Nature I meet with thousands of illustrations in the same direction. And I conclude—I cannot help concluding—that these, too, are the fruits of active will, of reason, of love—in a word, of a person in whom all these reside.

But the inquirer does not stop here. He is not satisfied with the induction which a multitude of facts warrants and makes sure, that a living agent is the source of the power which lies behind the phenomena; he seeks after Him if haply he might find him. Thus, natural theology becomes more in wise hands than a defensive armour—its whole tendency is to allure towards God. In the evidences of plan, of design, and in the varied adaptations and adjustments of organic and inorganic nature, light is shed on His person and presence. In the revelation which he has given of himself in the Bible he is clearly seen, and we are led to love him. But it is just here where our studies assume their highest bearings. We trace our Heavenly Father's presence everywhere, and we dwell on the fruits of this, that we might be led into higher admiration, deeper reverence, and more ardent love.

II. If, then, we isolate nature from such moral con-

siderations, we destroy its truest and highest significance and interest. For example, in the subject now under notice—the great features of the earth's surface, the configuration of its continents—we are left wholly in the dark, as to purpose, design, adaptation, unless we find close and intimate bearings on the work and destinies of man. What at first sight seems so fortuitous as the contour of a country? What, apparently, so haphazard as the outlines of a continent? Yet a glance at these from the point of view of physical geology, on the one hand, and the condition of men associated with them, on the other, presents us with most interesting subjects of thought. But in approaching these, let us take heed that we do not push our inductions too far, and do not attempt to base our inferences on facts which might be questioned. With this caution, however, we cannot resist the impression, that as in the kingdom of grace God manifests his sovereignty in the election according to kingly and absolute will, so in the wide kingdom of men, in the universal human family, he discovers the same sovereignty in the habitations assigned to, in the work required from, and in the opportunities of service given to certain great divisions of the human race. This, itself, apart from other considerations, is not without use as an analogy. The subject under notice will bring us to the illustration of these remarks. If they be true, as we think they are, they may be suggestive of some new points of view in the moral government of God.

Ritter, the prince of physical geographers, was the first to call attention to the fact, that a most intimate relation obtained between progress in civilisation and the contour of continents inhabited by the leading divisions

of the human race. Indeed, he went so far as to make the former wholly dependent on the latter. A glance at the geological map of the world will illustrate this.

The southern extremities of all the continents are bold, massive, abrupt. In America there are the rocky precipices of the last links of the Andes at Cape Horn. In Africa, the high plateaux of the Cape of Good Hope, and the peak of the Table Mountain. In Asia, the outlines of the Ghauts, terminating in the rugged rocks of Cape Cormorin ; and, if we assign the rank of a continent to Australia, there are the abrupt masses at South Cape, Van Diemen's Land. In these again, to the east of their southern peaks, a large island or group of islands occurs. America has the Falkland Islands, Africa has Madagascar, Asia has Ceylon, and Australia has New Zealand. Another characteristic feature is the tendency of the land on the west and south-west to press towards the central mass of the continent. In America this is seen beginning at Cape Blanco, and obtaining its highest development at Pisagua Bay, on the coast of Peru, the summit of the bend being Cape St. Roque, on the opposite side ; while the coast line up to the mouth of the Amazon has a remarkable resemblance to the coast line of the concave bend on the African coast from below Sierra Leone to Fernando Po. In Africa, the bend towards the interior is thus represented by the Gulf of Guinea. In Asia it is marked, though less distinctly, by the Arabian Sea, the extremity being the Gulf of Cambay. In Australia it is seen on the south in the great Australian Bight.

If we look at the proportions of land and water, we see that there is more land at the north than at the south ; that it expands as you approach the north, and

narrows as you proceed to the south. This feature has led to the grouping of the whole under two hemispheres, the land hemisphere and the water hemisphere; the former lying on the north of a circle drawn through Peru, and passing near the Cape of Good Hope, the latter taking in all to the south. London thus stands near the centre of the land hemisphere.

Once more, looking at the coast line of these continents, another most important feature strikes us. Some of the continents are marked by great irregularity, by deep indentations, by gulfs stretching far into the land, thus greatly extending the coast line. Asia has a coast line of 30,800 miles, or one mile of coast to 459 square miles of surface; Africa 14,000, or one mile to every 623 of surface; North America has one to every 228; South America, one to every 376; while Europe has one mile of coast line to every 156 miles of surface. It will at once be seen that these indentations serve two important ends:—1st, They break up a continent into many independent nations, separated by the water boundary at one point, but united by the land each to each; hence national rivalry, enterprise, patriotic endeavour. 2nd, They present a more ready access to foreign and distant nations, inviting in this way all those civilising influences which follow in the steps of legitimate commerce.

Now, let us add to these phenomena of contour those of elevation and depression, seen in the existence of mountain ranges, plateaux, and great plains, and a series of most deeply interesting adaptations are set before us. In most cases, the rise of land proceeds from the coast to the interior, where mountains reach a point of highest elevation. The gradual character of this slope is, no

doubt, sometimes partially interrupted, as is the case in the region about the Dead Sea and the Caspian, both of which are below the level of the ocean; but this does not alter the general fact. The highest range of land line is seldom in the centre, and the elevation for the most part proceeds from the poles towards the regions of the equator. What are the effects of this seemingly trivial fact? If the contrary were the rule, what would be the result? Would it not be found that those countries whose inhabitants are most noted at present for skill, for commercial enterprise, for all the arts of civilised life, and for the highest development of Christianised thought, would be frozen and uninhabitable—dreary fields of snow and thick-ribbed ice?

Another point attracts attention here, namely, the relations of the great Atlantic and Pacific depressions to the neighbouring continents. The long slopes of the mountain ranges run towards the Pacific, the short slopes towards the Atlantic. The former ocean is studded with islands, not only near the coast line of the continents, but at a great distance from them. But if we follow meridian 45° , which passes through Cape Farewell, Greenland, and strikes South America more than 100 miles to the east of the Rio Para, we have a line passing not very far from the centre of the great Atlantic trough. The absence of islands here at once strikes us. But take meridian 165° east or west, and we find the ocean on all sides of it studded with groups of islands. The Atlantic trough is an immense valley, sloping on the east and west to the shores of the neighbouring continents. The Pacific Ocean occupies a series of deep hollows, the ridges bounding which can be traced in the island groups.

The depression represented by the Atlantic trough has separated the land of the Old World from that of the New, and the violent volcanic action, whose traces are seen in numerous islands of the Pacific, has resulted in those deep indentations in the coast line, and in those shore-clusters of islands which, as we have seen, stand in such close relation to the progress of the race, and to the advancement of certain great families of man.

Looking at these phenomena from our present point of view, can we resist the impression that there has been the working of omnipotent intelligence—the putting forth of power on the part of Him who wields the most mighty of natural forces for the realisation of his will as to the world—as to man? The form of the surface as it now presents itself to us is the fruit of Divine plan; is, in a word, something which was foreseen before it was realised.

Thus, then, the following inferences from the phenomena now reviewed are warranted and legitimate.

1st. Continents have been developed according to a Divine plan; their present form is the expression of laws carried out thereto in the course of ages.

2nd. The earth was made for man, and was to be given to him. Had he been introduced earlier, the grant of the earth would have been in vain, unless on the supposition of several races having been created at the same time, and planted in different localities. There are not even the slightest traces of man up to the close of the tertiaries.

3rd. This growth of continents—this development of physical features in the enlargement of surface and in the great variety of outlines—was associated with palæontological characteristics as remarkable as those

we have referred to. There was development from lower to higher, from the *foramenifera* of the Laurentian rocks to the *mammalia* of the tertiaries, and from the latter to the bringing in of man. We must admit this. If then we attempt to meet the seductive materialism of the so-called Development Theory from the old point of view only, we will find ourselves foiled in the first encounter with the enemy. Let me illustrate this.

It was generally thought that the palæontologic aspects of the development theory had been conclusively set aside, by an appeal to the presence of very highly organised forms in some of the oldest fossiliferous strata. The object of this appeal, however, was the disproof of a gradual development of any sort, as the plan of God's revelation of himself in his works. The apologists who hastened to break a lance with "the development men" were not contented with setting aside the arguments of their opponents. Nothing would satisfy them but the total annihilation of the theory which had begun to work such havoc. The refutation was pushed beyond its proper limits. And a great feature of God's plan of self-manifestation came to be regarded with such suspicion, that danger was believed to lurk in the very word "development." It is to be feared that we are not quite beyond this yet. Under its influence we are apt to shut our eyes to the godlike grandeur of that purpose and plan which, in the history of God's self-revealing, we see gradually unfolding before us. In opening up these general adaptations we have already seen, that from earliest ages there has been growth, development, a grand march of the organic and the inorganic from little to great, from great to greater still. Our vantage ground when called to grapple with

the form of error now referred to, will be found in the intelligent appreciation of the facts, and in the frank acceptance of the law of development from lower to higher. There is so much truth mixed up with the error, that any attempt to see in it only error, is to do violence to the truth, and not to gain the sympathy of truth-seekers, who may be bitter, perhaps, and ignorant, but, nevertheless, honest.

In pleading for the recognition of a theory of development in the history of God's dealings with his own earth, we are in no danger of resolving all the phenomena of nature into one primal form, one great life-germ, whose beginning is lost in the darkness which stands on the threshold of the unrealised. Instead of this, we get quit of all disturbing forces, and narrow the ground for that personal encounter in which truth has never yet been, and never will be, overthrown.

In opening the Scriptures, this method of the divine government meets us at once. Take the creative days devoted to the realisation of the organic, the living, and what do we find? We find a march upward; we find gradual development as an outstanding feature in the Divine procedure. First we have the vegetable, then the living forms whose home is the water, then the fowls of the air, then the world of land animals, then man, animal and spirit, mortal and immortal, whose body makes him kin to all below him, whose soul removes him infinitely above all below him, and sets him next to the Creator himself. In all this we have a most suggestive analogy. As it was in these days of creation, so was it from the very dawn of life on the earth. No student could review intelligently the present scheme of zoological classification without feeling that,

in dealing with the *Infusoria*, he is in contact with animals much lower in the scale, taking structure as his guide, than he meets in the *Actinozoa*, or that these latter are far inferior, say, to the *Insecta*, which again are not to be compared with the class FISHES, the lowest of the true vertebrates. In complication of structure and associated features, the class BIRDS is as high above them as that of the true mammals is above birds, or as the genus *Homo*, in virtue of a higher complication still, psychical as well as physical, mental and moral as well as corporeal, is above the genus *Simia* or *Gorilla*.

No one can question the fact of upward progress in these cases. It is true that each is perfect in its kind, and that the simplest as well as the most complex bears its own characteristic testimony to the wisdom and goodness of the Creator. But here we have no occasion to give weight to this fact. It is granted by all. The value of the testimony, however, is comparative. We may admire the wisdom, for example, which can present us with functions analogous to those performed by true organs of locomotion in creatures in whom they do not exist, with the power of measuring distances where there are no eyes, with digestion without a stomach, with apparent muscular action where there are no muscles, and nerve action where no trace of a nerve system has been discovered; but such animals can never be held equal to those in which such functions stand closely related to corresponding organs and are seen to depend on them. In proportion to the measure in which the zoological systematist succeeds in truly interpreting the mind of God in his works, is his success in arranging them in an order true to nature. And as far as they are true to nature, they are seen, as we ascend, to point

to man. All the lines of creative power converge around him, who was made, though last, in "the image and likeness" of the Creator.

Now if we connect these thoughts with the views just given of the gradual development of the material earth, we shall see the value of the analogy. The earth's stages were characterised by distinctive groups of plants and animals. The marine protozoa formed the starting point; the higher forms in the lower groups followed; true vertebrates were introduced; and, when the earth was fitted for his habitation, man was ushered on the scene. While there had been prevailing types which determined the palæontological character of each great epoch, there had been other types scattered sparsely among them. When man appeared, all the lowest, equally with the highest, were associated with him, that he might stand out as the head to whom all the past had pointed, and around whom all the present creation is grouped.

We must admit, then, the fact of progress in creation—of gradual development of groups, of a rise from lower to higher. And it is here that we can without distraction look at, deal with, sift, and try the claims of genetic development of individuals from other individuals lower in life than they, and of a different type, or even of a different species. If any man volunteers the statement that dead matter, in virtue of some chance collocation, or under the influence of certain fortuitous forces, rises into life of the very lowest form at first, and gradually attains to higher individuality, until it reaches mind-endowed man, we need not charge him with atheism, for of that there can be no doubt, but we may ask him for facts. And if he try to draw us into the darkness

by appealing to remote geologic ages, we may be quite as able to read these oldest records as he is, and still ask for facts. But our ground would not be safe if we pushed any one set of well-known phenomena into antagonism with the principle of progress in creation to which we have referred.

It was here that Hugh Miller left a joint loose in that massive armour which he wore, and his enemies were quick to see it. Having, as in the *Asterolepis*,* found evidences of highly complicated structure prevalent in the remains discovered in palæozoic strata, he said, "Instead of progress we have a fall in the creative type." The earlier fishes and reptiles he held to have been more highly organised—characterised by a more complex structure than those which came after them. This induction he believed to be warranted, by observing that certain fishes had not only marks which gave to them specific individuality, but features which, afterwards, came to be realised in forms later introduced. Now this in reality was not degradation, but the contrary; not a fall from the creative type, but the setting of that type in a still higher relation.

A simple illustration will show our meaning. The studies and sketches of Raphael were distinguished by specific and characteristic features which none of the paintings founded on them possessed, while, at the same time, they had the general features, in outline, of the finished works themselves. But no artist would set the study of the sketch above the highly and elaborately finished work of art, on the ground merely of its twofold suggestive character, as being its own witness and the prophecy of the perfect picture; and no one

* A gigantic ganoid fish of the Old Red Sandstone.

would be warranted in affirming that there was a fall from excellence in the finished picture compared with the richly suggestive sketch. This is the weak point in Hugh Miller's otherwise magnificent argument; this is the feature, moreover, which his opponents have lifted into a position of such prominence as to represent it overshadowing all the rest. Nor can it be denied that they have found a most assailable point, when attention is directed to this. But no naturalist will now point to the heterocercal ganoids of the palæozoic strata, as higher in the scale than the homocercal genera later introduced, just as no observer would now claim a higher place for the cartilaginous sturgeons, representatives of the ancient ganoids, than for the osseous forms to which the great majority of present genera belong.

In Hugh Miller's day the question was surrounded with many difficulties, from which it is not easy to free it even now. Almost every working naturalist was carried away by the thought, that complication of structure should determine the rank of the creature in the systematic scale. Professor Owen was in his strength, and was working with wonderful success from this point of view—a point of view which Agassiz was among the first to question. Nor is it easy to hold and act upon clear and sharply defined convictions here, because there is a large and most important sense in which the theory under consideration is true. But there is another sense, as important, in which it is not true. Let me try to make this plain by drawing the distinction which undoubtedly exists in nature. Complication of structure should determine the rank of the creature when all the parts point to generic characteristics or to marks limited to the group in

which the animal occurs. But when complexity of character is the result of the presence of one series of parts belonging to the type under notice, and another series of parts which point to some other type, the position of the animal is, confessedly, much lower down. Now this was precisely the case with the forms illustrated with such power and eloquence by Hugh Miller. There were plain hints, not a few, in the structure of his ancient ganoids of reptilian forms, and their modern representatives exhibit the same. Thus the prophecy of the coming beings waited for its interpretation: the interpretation was met with in the bringing in of true homocercal fishes on the one hand, and of true reptiles on the other. The early ganoids had thus strong resemblances to fish, and as strong to reptiles, but the presence of both in one determines that one to be lower than the highest of the true species of either type. In human affairs it is indicative of far higher attainments in civilisation, when the industrial arts are practised by the men who have been trained to them, than when several arts are practised by the same man. Society is much more rude where the same man is carpenter and mason, blacksmith and village doctor, than where these arts are distributed among men whose time and talents are severally limited to each—where men are either carpenters, or masons, or blacksmiths, but do not unite in any one individual more than one art. Thus this feature, instead of being the contradiction of development, in the sense now pleaded for, is its illustration. It was the prophecy that the time was approaching when the piscine features would be embodied in the true fish, and the reptilian in the true reptile.

In tracing the self-manifestation of the Creator

throughout this upward movement, we should carefully keep before us the central thought which pervades the slow and measured march of creative energy—we mean the ushering of man into being. As we have already seen, this unites everywhere moral elements with physical phenomena. Now, there are certain steps in this progressive development, this gradual increase of inorganic bulk, and of organic forms, at which we have not yet glanced, but which will reward the student of the ways and works of Jehovah for whatever time and labour he may spend in his efforts to understand them fully and clearly.

The steps are all well marked. We do not indeed mean to say, that they are so well defined that even the uninstructed can trace them. While there are just so many features of uncertainty about them as to warrant a strong protest against hasty generalisations, there is yet so much certainty that we are fully justified in saying, that this epoch or that has a distinctive existence, and is marked by physical features peculiar to itself. Doubts may be raised as to whether Cambrian and Silurian are words which should, if truly applied, characterise one great group of rocks. But no doubt exists that these words truly express one well-marked period of the world's history whose remotest point was associated with the so-called Cambrian rocks, its middle with the lower, and its top with the upper Silurian. If this last seem to merge in the Devonian series in their lowermost members, the appearance does no more than point to the transition from the one period to the other. Thus is it, indeed, with each group of strata to the top of the Permian; and here all is clear and distinctly defined. Even if we were constrained to give up the theory of

well-marked boundaries between those mentioned, we should discover unmistakable evidence of a well-defined period at the close of the Permian. So that if the series of rocks named Laurentian, Cambrian, Silurian, Devonian, and Carboniferous, failed to illustrate the theory of well-defined and separate epochs characteristic of each, the whole grouped together leaves us no room for any other conclusion. Here, then, at least, the footprints of the Eternal are well and deeply marked; and they are so in order that man in the last days might be able to trace them. If so, how blameworthy the ignorance which refuses to enter into the Creator's purpose, and to learn to read the marks which bear witness to its gradual manifestation!

Thus we are not called on to give heed to geology merely because a knowledge of its terminology and its facts will enable us to enter into and to take an intelligent part in important controversies, or because no science has such intimate bearings on national prosperity. These, indeed, are important ends, but to thoughtful Christian men its chief charm has ever been found in that light which it sheds on the ways and works of the God and Father of our Lord Jesus Christ, in Him *our* Father and best and heavenly Friend. When under the power of this motive, we cannot help feeling that this branch of natural science is opening up to us sources of information almost kindred in impressiveness with those of the written Word.

There is, however, abundant evidence that the Creator did not regard these steps of creative progress, though well marked and defined, as complete in themselves. If studied by themselves, and not in the light which different parts of each period throw on the whole, we

should very frequently fail to see any of those general adaptations to which reference has been made. For example, if we again insist upon the importance already given to the assertion, that the vegetable was formed for the animal, what could we make of the luxuriant vegetation of the coal measures? What was its use? Not certainly the support of a multitude of vegetable-feeding mammalia, or of any kind of vegetable feeders. No such animals existed at the time. Here we have a flora without a fauna to feed on it. Men talk eloquent nonsense about the adaptive power of ever-working and evenly-working general laws, laws which determine that where the food is, there will be the animals to eat it, laws which make no mistakes, admit of no interruptions, but which in their action keep up the perfect harmony between every form of being. But here—and I would put it as broadly as it can be put—here we have an order of things in no way adapted to the period at which it appeared, for the fauna of the coal measures was not herbivorous. And yet what a magnificent argument in natural theology is deducible from this very circumstance. The physical condition of the earth at that period was, by a personal overruling One, brought into existence in order to the production of a material which was to be adapted to the circumstances and wants of a race to be born millions of years later. Talk, indeed, of law as equal to such an adjustment, as equal to bring into being and to guide to fullest development the vegetation which, in some form, was to be stored deep down in the earth, and to adjourn for great ages the appearance of the race who were alone to benefit by the provision! “But it was law in the hands of an Omnipotent and All-wise One.” True, but

why not say so at once, and not discourse of "law," as if it were everything. If you grant a controlling will, that is all that we plead for. This granted, why not regard phenomena from this higher point of view, and accept and readily acknowledge that natural law is nothing more than the form through and under which the power and wisdom of the Supreme Creator, Ruler, and Judge, are manifested and brought into action.

While on this point, we call attention to an expression which occurs in Gen. ii. 5 : "There was not a man to till the ground ;" to till, *ahvad*, to work, to make it yield to him its treasures, to serve the ground in order that a profitable return may be gained. This word is applied in the first place to the preparation of the surface soil, in order to its continued fruitfulness. But we learn from the sacred narrative that it soon came to have a wider import. Meanwhile, notice that the very arrangement which has been pointed out in regard to the vegetation of the coal measures, has its illustration here. The present order of things was brought about, the sun shone out in his strength. God made the stars also ; there was day and night. Land and water had been definitely separated. The land was stocked with forms of land life ; the belt of ocean was now life-teeming. The herb and tree flourished luxuriantly. He who at former epochs had delayed the coming, by direct creation, of him who was to be made likest to his Creator, and to become unlikest, might at this period also have put man's appearing far off. But this was not in the Divine purpose. The time determined from eternity had now arrived. God looked on the results of each day, and all seemed very good. Link after

link had been formed, but now the last rivet for the last link must be brought forth. "All is good ! But there is not a man to till the ground. There is not a man to make all the past answer to my high behest and purpose—not a man to lay his hand on the soil, and to rest his heart on me, that past creations might show forth my glory. 'Let us make man.' 'And the Lord God formed man. And man became a living soul.'"

Now if we associate with this view the remarkable fact, that the industrial, mechanical, and fine arts sprung into full development among Adam's grandchildren, might we not conclude, that, in their case, "to till" implied more than to work the surface? The very circumstance itself, that the use of coal, iron, and lime, is implied in the arts practised by the immediate descendants of Cain, will convince us that the eager, restless spirits, sprung from the elder branch of Adam's family, had truly "tilled," had made the earth yield service to them for their service of work on her, and again we see the adjustment completed. The limestone had been formed in the ancient carboniferous seas, or in the inland lakes of the period. The ironstone had been prepared by most complicated and elaborate processes of natural chemistry; and they all waited for man to take them and apply them to the purposes for which they had been stored up.

This line of remark may be carried still farther. We may take into account the present highly complicated social relations of man, the progress of nations, the characteristics of present civilisation, and even the work given to the church to do, and we shall not fail to notice very many things which associate all these with the pre-

paration thereto in the very earliest ages of the world's geologic history. In the church the analogies are many and most suggestive. How could the tabernacle and the temple have been set up, but for the material prepared thereto, ages before, by Him of whose revelation in a true body the tabernacle and temple spake? The sword which wounded the side, and the nails which pierced the hands of Him who has become to us our hope and joy—"the ocean to the river of our thoughts"—were formed of that substance which the Creator intended to serve high ends, in connexion with the social comfort of the human race. Man perverted it, and used it against God's dear Son—"Him ye have taken, and by wicked hands have crucified and slain."

Returning again to the review of the topics suggested by the geology of the surface, we notice a further inference, namely this—that there is nothing fortuitous in the present contour of continents, in the extent of their coast-line, or in the depths of their indentations. What would be the effect if Europe and Asia were deprived of their present form, by having all their islands massed with them, their peninsulas destroyed, and a uniform unbroken coast line assigned to them? The answer is not far to seek. There would be an arrest laid on every movement for which Europe especially is now noted. Commercial enterprise would be almost impossible. Intellect itself would stagnate, and the proud Caucasian might, in no great time, become like the Mongol or the Negro. There would be the decay of moral effort, and of intellectual energy. Thus, again, these seemingly fortuitous features in the surface geology of a country come to be associated with the Divine

forethought, with the action of a controlling Will, yea, with the constant working of the living and blessed God.

If we were to limit our review to any one portion of the earth's surface, where great events have happened, and whose inhabitants have been used in bringing about the very highest ends in the moral government of God, the same forethought would meet us at every point. For example, it is seen in assigning to Western Asia the honour of having been the cradle of the human race, and especially in giving Palestine to the Jews. As to the former, any one refusing to look at this subject might say, if it had pleased God he might have planted Eden in the heart of Africa, or in the dreary wastes of New Holland. True! But that he did not do so, invites us to try and penetrate the cause of his choice. The first step in this direction sets us again in the heart of phenomena with which it is the province of physical geology to deal. But what can be more interesting here than to mark the varied proofs of the prescience of God, in placing man, at first, amidst scenes fitted both to gratify his common and familiar tastes and habits, and to develop the highest elements of his moral nature? It must ever remain significant, as to God's will in regard to work and effort, that the soil of Eden, even before sin defiled the heart of the lord of the soil, was nothing to man without work. He was to dress the garden and to keep it. He was to till the ground. In this mode of life were conditions consistent with innocence. The exact locality need not be determined. If we know the region, it is sufficient for our present purpose. It seems past questioning, that the region which had yielded a pleasant habitation

to the first pair, was none other than that which, as a centre, was desolated by the wild waters of the Noachian deluge.

In glancing at it from this point of view, we are on sure ground, because on the question of the dispersion of the immediate descendants of Noah, historical criticism has a more firm foundation than it has on that of the site of Eden. The lines of the dispersion have been traced with some certainty to the district pointed to in Scripture. Its leading features were admirably adapted, both as a resting-place and a starting-point, and are suggestive of God's will and God's wisdom, in connexion with the fitness at that time of the region for the human race.

Let us here keep before us, in a general way, the more obvious features in the physical geography of the vast tract of country which more or less came to be associated with early Scripture history. This history may be broken up into three great divisions; namely, the period from Adam to Noah, from Noah to Abraham, and from Abraham to Moses—the antediluvian, the patriarchal, and, what may not inaptly be called, the embryo-national periods. The purely Hebrew or Jewish element in Scripture history dates rather from the mission of Moses than from the call of Abraham. The church during the Abrahamic period was not confined to the household of Terah's son. Its members demanded a much wider platform than that lying between the range of Ararat on the east, and the Hellespont on the west—that is, the whole of Asia Minor—wider even than the great tract lying between the Tigris and the Mediterranean Sea in its northern division, and between the Persian Gulf and the Red Sea on its

southern division. The range of Ararat has sometimes been assumed as a centre, from which the gradual dispersion of men, both in Adamic and Noachian times, has been traced: but both climatal and industrial considerations would make the migration from the original seat of the human race, and from the spot where the ark rested, tend towards the east, west, and south, rather than to the north. The physical features of the surrounding region would also have a well-marked influence. To the north, they would be met by the barriers of the Caucasus, stretching like a mighty natural wall between the Black and the Caspian Seas. Comparatively little progress could be made towards the east without meeting the waters of the Caspian, whose shores, running southwards, would guide men gradually into the immense plateau of Iran, which, strictly speaking, may be held to extend from the Indus to the Nile. Between the range of Ararat and the Caucasus on the north-west, they would meet the shores of the Black Sea, and, following them in a south-westerly direction, they would ultimately be led directly west, towards the Grecian Archipelago, and, indeed, into the whole tract of Asia Minor. The fertile valleys of the Euphrates and Tigris, with those of their confluents, would lead them to the south, to the east, and to the west. The earliest historical traces of the location of the sons of Noah are in complete harmony with this sketch.

The region now under notice includes the whole of those vast tracts known to us at present under the names of their modern political divisions, as Affghanistan and Beloochistan, Persia, Arabia, and the Lesser Asia, with Egypt to its western boundary on the

Libyan Desert. In looking at its physical characteristics, Ararat is taken as a starting-point. From the two conical peaks which give their names to this vast range, the chain of mountains which stretches southward has the ancient Asshur on the west. The main ridge, as it runs to the south, throws off, to the east and to the west, a multitude of subordinate ridges. The great mass of rocks composing this range are igneous. To the west of this chain the great ranges of the Taurus and Anti-Taurus mountains diverge into Asia Minor; the latter being broken up into two main divisions, the northern and southern, the former extending from the mountains of Asshur to the Mediterranean, and along the northern shores as far as the Hellespont. In its approach to the Great Sea it throws off to the south the ranges of Lebanon and Anti-Lebanon, which run from north to south through the whole of Syria, having here and there ridges which meet them at right angles. Limestone, gypsum, sandstone, and volcanic rocks, constitute the bulk of these. Many of their slopes are well-wooded, and in their valleys flowering shrubs and herbaceous plants are met with in great luxuriance. In addition to these great chains, which stretch out from the snowy peaks of Ararat, another range lies at some distance from the western and southern shores of the Caspian, and strikes away to the east into the northern parts of Affghanistan, in a line more or less continuous; here and there throwing off diverging arms towards the south.

The river system of this great region is associated with the most important events which have occurred in the history of the world, both in ancient and modern times. On the west we have the Nile, and on the east

the Indus. Then we have, rising among the mountains of the great range of Ararat, the Euphrates and Tigris, which drain territories noted in Holy Writ and in profane history; the Halys or Kizil-Irmak, and the Aras or Araxes, the Gihon and the Pison of Eden, which empty their waters, the former into the Black, and the latter into the Caspian Sea.

As was to be expected, a region extending from 30° to 70° E., and from 45° to 25° N., exhibits a remarkable variety, both in its forms of animal life and its vegetation, while its mineral characteristics are no less striking. Extending, moreover, from Scythia on the north to the Indian Ocean on the south, and from India on the east to Lybia on the west, its climate passes from the extremes of intense cold to those of intense heat. Its zoology, besides including most forms of animal life to be found in Europe, embraces a great variety of its own. This will be seen when it is stated that it includes the monkey, lion, tiger, wolf, bear, racoon, hippopotamus, camel, stag, horse, rhinoceros, coney, and elephant, among mammalia; and representatives of all the orders of birds. Among its reptiles are turtles, crocodiles, lizards, snakes, etc. Its vegetation includes all the characteristic forms of cold, temperate, and tropical climes. The list of precious stones to be met with in this district will give us an idea of the riches of the tracts bordering on the original seat of the human race. Onyx, cornelian, garnet, diamond, malachite, lapis lazuli, jasper, amethyst, topaz, ruby, emerald, sapphire, blood-stone, etc., besides silver, gold, iron, lead, and copper. In its seas, pearls abound.

The same line of remark might be followed in regard to Palestine itself, its mountain ranges, its plains, the

valley of the Jordan, and its coast-line, taking in the Mediterranean on the west, the Dead Sea in the interior, and the eastern horn of the Red Sea. Enough, however, has been said to make it plain that the features of the land which witnessed the origin of the race, and that in which the Jews as the chosen people, the witnesses for God to the world, dwelt, were most admirably adapted, first, for the preservation of their inhabitants; second, to afford both inducements to spread themselves abroad, and abundant facilities thereto; and, third, to provoke to industry, in its three great branches—agriculture, manufactures, and commercial enterprise. The story of Babylon and Nineveh, the pastoral greatness of the patriarchs, and the naval expeditions of the reign of Solomon, might furnish numerous illustrations of these remarks. Nor is the edge to be taken off such statements, by asserting that other countries, other regions, might be pointed to in which all these features meet. It may be safely averred that this is not so. Even Britain, which more than any other nation has in her own experience illustrated these characteristic features, could never have formed a suitable natal sphere for the earliest of our race.

Thus, then, we strike two lines of adaptation, two systems of proof of creative forethought on a large scale. On the one hand, we have a series of moral adaptations; and on the other hand, a series of purely physical ones. In the former, He who knew the end from the beginning, foresaw a race fallen from holiness, from a true knowledge of themselves and of their Creator, and provided a remedy equal to all the wants of their spiritual nature; and, in the latter, he determined the physical

conditions most conducive to the maintenance, the enterprise, and the spread of those for whom the whole earth was provided. Those who receive the grace are to hasten, if need be, to the ends of the earth to make it known to others; and as all are partakers of the goodness, all owe to God the debt of gratitude, the offering of thanksgiving from loving hearts.

CHAPTER VII.

GENERAL ADAPTATIONS CONTINUED.

The ocean—Constituents of sea-water—Quotation from Professor Forchhammer—Oceanic equilibrium—Moral influences—Eccles. i. 7—Oxygenation of the waters—Quotation from Guyot—Biblical references to the sea.

THE second series of general adaptations are connected with the ocean. They are not less interesting than those associated with the land, regarded as God's special gift and grant to the human race. It is, no doubt, true, that they do not lie so ready to hand, and so immediately within reach of the student, as the others. Nor are they likely to be so generally appreciated. The great majority of men have little or no connexion with the sea, and consequently they do not enter so readily into sympathy with the labours, researches, and discoveries of those who have. Let us mark the presence of the Almighty One in some of the outstanding and evident oceanic adjustments. We take, first, those associated with the constituents of the water of the ocean. The number of elements hitherto found in sea-water is thirty-one. I give here Professor Forchhammer's list, which is the most recent. These are oxygen, hydrogen, azote in ammonia, carbon in carbonic acid, chlorine, bromine, iodine in fuci, fluorine in combination with calcium, sulphur as sulphuric acid, phosphorus as phosphoric acid, silicium as silica, boron

as boracic acid both in sea-water and in sea-weeds, silver in the *Pæcillopora alcornis*, copper, very frequent both in animals and plants of the sea, lead, very frequent in marine organisms, zinc, principally in sea-plants, cobalt and nickel in sea-plants, iron, manganese, aluminium, magnesium, calcium, strontium and barium, the latter two as sulphates in fucoid plants, sodium, potassium, lithium, cæsium, rubidium, and arsenic. Of these elements only a few occur in such quantity that their determination has any notable influence on the quantitative analysis of sea-water—viz., chlorine, sulphuric acid, magnesia, lime, potash, and soda. The others, as far as their existence has been determined in the sea-water itself, are found in the residue which remains after evaporation to dryness and redissolution of the salts in water. As far as the principal ingredients go, they are to be met with universally, and almost always in the same proportions. Thus, if chlorine be taken as equal to 100, the mean proportion of the other leading constituents is as follows:—

	Mean proportion.	Maximum.	Minimum.
Sulphuric acid.....	11·89	12·09	11·65
Lime.....	2·96	3·16	2·87
Magnesia.....	11·07	11·28	10·95
All salts	181·1	181·4	180·6

In a paper communicated in November, 1864, to the Royal Society of London by Professor Forchhammer, of Copenhagen, he points out that this constant proportion of the different constituents in the ocean depends evidently not upon any chemical combination and affinity between the different substances, but upon the enormous quantity of salts in the whole ocean, which renders imperceptible any difference that might otherwise arise

from the different proportion in which salts are carried into the sea by rivers. It depends, besides, on the uniform action of the numberless organic beings inhabiting the ocean, which abstract sulphuric acid, lime, potash, and magnesia from the water, and render them insoluble.

In equatorial regions there is a constant tendency to break the balance indicated in these words. The evaporation near and under the line is far more rapid and extensive than in temperate zones. And though there is a constant neutralising element in the rains which fall on the sea, and the waters which reach it from the land by the rivers, yet this would not be enough to keep the proportions uniform. But the "equilibrium is maintained by polar currents, which bring water with less saline matter to the regions of the equator." These phenomena of adjustment warrant the following inferences :—

1st. The water of the ocean has been prepared in order to the support of oceanic forms of life. The principal ingredients would in time have become excessive and have destroyed life, instead of supporting it; but the living forms become the guardians, as it were of their own existence, by constantly abstracting the chief elements, and thus keeping the way open for their unceasing growth. This is done by assimilating the elements to different parts of their bodies, and, in a sense, abstracting them from the water to render them permanent and insoluble. In the case of fishes, for example, some go to the general tissues, some to the bony skeleton. In the case of molluscs, some are appropriated by the fleshy body, and others by the shell; so that the very elements which would have become hurtful, if permitted constantly to increase without change,

serve the very highest ends, while they yet continue in the same place and proportion, by being thus appropriated by living bodies. But even in their case these elements must not be held too long. They die. And in the gradual decay of their bodies, in the slow waste of their shelly coverings, the elements are either given back when they are needed, or these forms of life are devoured by others and brought into connexion with other elements, in order that, after a combination of most important and complicated reactions, they should again return to their original form, to minister, once more, to the support of life like their own.

We say, "support of life like their own;" a remark which may be made casually and without much thought. But let us look at the facts. Think of the number of elements which have been obtained by chemical analysis from the sea, or from the animals and vegetables which inhabit it—elements which they, in their turn, must have taken from the water—and does not a natural chemistry of a most subtile kind, and yet on a scale great as ocean itself, stand out before us, and claim our admiration? Then we associate the animal life and vegetation with the sphere in which they exist, and notice unnumbered adaptations as remarkable as those between land forms of life and vegetation, and the surrounding atmosphere. Linking these things in the mind, we shall not fail to enter into sympathy with the Psalmist, when we stand on the shore and look out on "the multitude of waters," "Let the seas praise Him, and everything that moveth therein."

But the waters of the ocean are fitted for a yet higher purpose in connexion with this support of marine forms of life—a purpose in the full carrying out of which

moral elements come again into play. They not only become a vast highway for the navies of the world, hastening hither and thither for ends of conquest, or for the higher ends of peaceful commerce; they supply materials for the building up of solid and compact masses, which become the island homes of tens of thousands of our race. In certain parts of the ocean myriads of coral polypes are ever at work, secreting from the waters in which they live calcareous matter for their polype-stocks. This work goes on over wide areas, and island after island have in the course of great ages raised their heads above the surface of the sea, while the parts which touched the atmosphere have been worn down by its influence, and thus they have had a soil formed fit to receive the seeds carried on the winds or by the birds which frequent them. They became clothed in time by a luxuriant vegetation, and are ultimately prepared to receive man as an inhabitant. The development here, even as in the building up of the great geologic periods, has been gradual, and ever with an eye to man. The results, when compared with the workers, are remarkable. All this is the fruit of worm-workers, whose organisation is of a most simple kind, and whose instincts correspond with their simple forms. Yet they are all

“Unconscious, not unworthy, instruments,
By which a Hand invisible was rearing
A new creation in the secret deep.
Omnipotence wrought in them, by them, with them;
And what Omnipotence alone could do,
Worms did.”

2nd. The presence of the salts in the waters of the ocean increase their specific gravity. Hence their fitness to receive great ships, and to carry them to their destined

havens. But this very excess of salt specially fits the waters for being acted on by the sun. Evaporation takes place unceasingly over the whole surface of the sea. Now, if there were no counter-forces at work to compensate for this, the waters would become wholly unfit for supporting life of any kind. But mark how the balance is maintained, and by what an easy, though beautiful and delicate adjustment, the waters are ever renewed, and the elements which they need ever restored to them. Hundreds of miles from the nearest coast-line these vapours, which have risen from the sea, fall to the earth as rain. The rains travelling down roaring cataracts, or in pleasant, fertile valleys—sometimes just after they had fallen from the clouds—take with them the elements once more needed for the tissue of fish and mollusc, for the body of the coral polypes, and for the houses which they are ever building in order to receive man. Thus the ever-recurring circle on which the wise King of Israel loved to meditate:—"All the rivers run into the sea; yet the sea is not full; unto the place from whence the rivers come, thither they return again." (Eccles. i. 7).

3rd. There is a provision for oceanic circulation. It is hardly possible to look at this without finding in it an analogy to the circulation of the blood in man. The heated waters of the tropical seas hasten towards the north to modify the climate of northern regions, and the polar currents travel to the south to restore the balance disturbed by evaporation. One region seems to serve the purpose of a great throbbing and unresting heart, from which streams flow to all quarters, and continue, age after age, to pass through the vast cycle of their rotation. Connected with this, there is what may be

called the oxygenation of the waters, a phenomenon answering remotely to the oxygenation of the blood. In the latter case, the life element is inhaled immediately, in the former, it is mediately and indirectly. If the water is to answer its very highest ends, if it is to support life and minister to the wants of man, it must ever be replenished with the vital element. Now, notice, with what a series of simple adaptations this is connected. The sun becomes obscured, and the breeze freshens from the sea; dark clouds gather on the horizon, and the "tide begins to return; the heavy waves now tumble towards the shore, and as they break in angry foam portend a storm. The sky looks threatening, and the thunders growl in the distance; the sea awakens up from slumber, and the blackening heavens lour over its dark bosom,—while the rising blast, impelling all the waves, drives them upon the rocks in sheets of feathery foam, till at length ocean and sky seem mingled. The raging winds now—

‘Take the ruffian billows by the tops
Curling their monstrous heads, and hanging them
With deafening clamours in the slippery clouds,’

from which they fall into the deep.”

Thus the atmosphere meets the ocean and loads it with the elements of life and health for the unnumbered tribes which inhabit it. Indeed, this influence of the atmosphere on the ocean supplies numerous illustrations of a presiding supreme Will, an all-wise and absolutely good Creator, and Ruler of all. Again, “the winds raise the waves of the ocean by an action wholly mechanical, and producing a superficial and local agitation; but when they blow constantly in the same direction they impart to the waters a motion in the direction of their

own course. The sun and moon pass over the surface of the seas, and the entire mass of waters, obedient to the mighty attraction, piles itself up in a wave of which the summit follows the course of the dominant luminary. This wave occasions the tides. The unequal pressure of the atmosphere on the different points of the ocean, from which result differences of level, and above all, the differences of temperature between the tropical and the polar seas, to which correspond different degrees of density, are so many more causes disturbing the equilibrium of the oceanic waters, and creating in their bosom various motions which continually tend to equilibrium, but which never produce it. Sometimes the superficial mass is transported from east to west, as in the great equatorial current; sometimes a deep and narrow band, a true oceanic river, flows rapidly through waters comparatively tranquil, as the Gulf Stream. Here currents meet and unite; there they are separated, and the upper and under currents run in opposite directions. Everywhere change is going on; there is nowhere absolute inaction, which is as unknown to nature in the ocean as elsewhere."*

There can be no disputing the evidences of Divine wisdom in these adaptations, and in this vast system of interaction between earth and air, and air and ocean, which even the general facts glanced at open up to us. The theme might be followed into much deeper relations; but let us trace those already noticed, plainly or indirectly, in the light which is cast on them by the Word of God.

It has been already remarked, that the key to the understanding of phenomena, largely dwelt upon and set

* Guyot.

prominently before us in the early books of Scripture, is often to be found in books written much later. It is so here. We may, then, bring together the various Biblical references to the sea, and set them in aspects fitted to shed light on the phenomena which are now under notice. Never are the allusions of the writers of Scripture to the appearances and the facts of the material world so suggestive and instructive, as when the full light of recent science is made to fall on them broadly and directly. We saw how truly this was the case in regard to "light." It is equally so as to "the sea."

Near the middle of the last book of the Bible, a remarkable verse on this topic occurs. The angel clothed with a cloud and rainbow-crowned, whose "face was as the sun, and his feet as pillars of fire," was sent to unfold the purpose of Jehovah; and the burden of his oath was an appeal to him as the Ever-living, "he swore by Him who created the sea, and the things which are therein." Thus, the sea is set in the sphere of the church's devout study. Be its phenomena what they may, interest is thrown around them for all who truly love their Creator. If many who do not love him, and who refuse to acknowledge him as their Father, show more intelligent interest in the sea, and the things that are therein, than those do who say that they love him, it is to their shame, it is a testimony against their ignorance. If I am to be all that my heavenly Father desires me to be, I must learn to look on all his works as he does. "He created the sea." Were there not another reference to this fact, this passage were enough, in itself, to explain why the Scripture writers have so frequently drawn on its phe-

nomena, to give point and power to their descriptions of the ways of Jehovah.

“God called the gathering together of the waters, seas” (Genesis i. 10). This unstable element must, like all other elements, be put under law, and confined within bounds, that there might be a habitable earth for man and all the creatures around him. Thus the Psalmist sings, “He gathereth the waters of the sea together as an heap: he layeth up the depth in store-houses” (Psalm xxxiii. 7). The boundary was such as to cause his servants to wonder. They looked from the shore, as we do, and under the influence of a well-known law, the billows in their heaving swells seemed as if they would, or as if they did, touch the sky itself; and as if they were so much higher than the shore, that they were in danger of leaving their basin and stretching over the land. Just such an impression, we, with all our science, popularly hold. The prophets thus looked as we do, and under the same kind of feeling. How wonderful, they thought, is all this! A low barrier of sand is made Jehovah’s agent for bounding the deep. “The Lord hath placed the sand for the bound of the sea, by a perpetual decree, that it cannot pass it: and though the waves thereof toss themselves, yet can they not prevail; though they roar, yet can they not pass over it” (Jer. v. 22). “He hath compassed the waters with bounds, until the day and night come to an end” (Job xxvi. 10). And one who knew the Father’s motives here—the eternal and uncreated Son himself,—says, “When he gave to the sea his decree, that the waters should not pass his commandment, then I was by him, as one brought up with him” (Prov. viii. 29). This reference to Jesus in his eternal Sonship takes us

much farther back than the present epoch. It takes us to the very foundations of the earth ; to those seas out of which land first rose, and which at the beginning were peopled with the living forms introduced by the Creator.

In the inspired narrative of the establishment of the present order of creation, the sea is first represented to us as hidden from the gaze of all creatures. "Darkness was upon the face of the deep" (Genesis i. 2). But even then it was well known and perfectly seen by Him who was about to stock it with a new world of created beings. And the Lord lays claim to this knowledge, as a reason why his people should be humble before him. "They are as yesterday." "But where," he asks, "wast thou when I laid the foundations of the earth? Who shut up the sea with doors, when it broke forth, as if it had issued out of the womb? When I made the cloud the garment thereof, and thick darkness a swaddling band for it?" (Job xxxviii. 4, etc.) The sea is God's, and all its phenomena; its teeming forms of life; its season of calm, when the waves thereof are still and the fleecy cloudlets on the peaceful sky are mirrored in its glassy waters; its time of storm, when it is tempest-tossed, or when breaking the power of great navies in its fury; all these are the wonders of God. These are "the works of the Lord, and his wonders in the deep. For he commandeth and raiseth the stormy wind, which lifteth up the waves thereof. He maketh the storm a calm, so that the waves thereof are still" (Psalm cvii. 24, 25, 29). "O Lord, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches; so is this great and wide sea, wherein are things creeping innumerable, both small and

great beasts. There go the ships ; there is that leviathan, which thou hast made to play therein. These wait all on thee " (Psalm civ. 24-27). Thus the exhortation, "Sing unto the Lord a new song, ye that go down to the sea, and all that is therein " (Isa. xlii. 10). The ground, the cause, of this song and the motive thereto is the discovery on man's part of God's absolute sovereignty over the deep. Most of the writers of Scripture were under the power of this thought. "Thy right hand, O Lord, is become glorious in power. . . With the blast of thy nostrils the waters were gathered together, the floods stood upright as an heap, and the depths were congealed in the heart of the sea " (Exod. xv. 6, 8). "He divideth the sea by his power " (Job xxvi. 12). "He turned the sea into dry land " (Psalm lxvi. 6). Thus saith the Lord, "I covered the deep for him, and restrained the floods thereof, and the great waters were stayed " (Ezek. xxxi. 15). In the same strain many more passages might be given. These are quoted to introduce us again to the manifestation of the sovereignty wielded by Him who was bone of our bone. He who set bounds to the deep ; he who walked before the chosen people in the march out of Egypt, and laid his hands on the Red Sea, making a path for them to pass over, was the same who, in later times, walked on the deep waters, and by one word from his potent and kingly lips bade the raging waves into a great calm, or hastened their inhabitants to the point where his disciples waited with their nets, or brought to the appointed place on the shore, to which he sent one of his servants, the fish with the stater in his mouth.

Now it might have been inferred from all this, that they who were in fellowship with him would seek to

understand his wonders in the deep, and to become familiar with the sea's innumerable progeny. So they did. Yet but scant attention is now given to it from this the highest, and, indeed, the chief point of view, by those whom he calls to enter into his thoughts in all his words, and works, and ways. It was not so with these men in the olden time. Looking at their position, the minuteness of their information is truly remarkable. They found it, to use their own word, "a storehouse." They saw that it could be made to tell forcibly the tale of its Creator's wisdom, and power and goodness.

As an illustration of their close observation, take Lament. iv. 3, "Even the sea monsters draw out the breast, they give suck to their young ones." It is doubtful if, with all our light, in making a reference to the inhabitants of the sea, with the view of teaching some great moral truth, many men would have ventured on such a statement as this. To do so, would not be remarkable in our case, because of the knowledge we have of the *Cetacea*—true placental mammals. But it was different with those whose information must have been limited to the Mediterranean forms of aquatic mammals. Only an occasional whale would, then as now, find its way to the shores of Syria. The seal and the dolphin are, however, to be met with in abundance. Now, the prophet knew and expressed the difference between them and the fish of the sea,—“They drew out the breast, they gave suck to their young.” But there is proof that the information was even more minute. Thus the command of God by the mouth of Moses—“These shall ye eat of all that are in the waters: whatsoever hath fins and scales in the waters, in the seas, and in

the rivers, them shall ye eat. And all that have not fins and scales in the seas, and in the rivers, of all that move in the waters, and of any living thing which is in the waters, they shall be an abomination unto you" (Levit. xi. 9, 10). Water and amphibious *Reptilia*, *Mollusca*, *Crustacea*, *Annelida*, *Echinodermata*, and *Acalepha*, were forbidden. But the precept implies familiarity with the forms of life to be included under what is termed "whatsoever hath not fins and scales." One of our ablest Hebrew scholars and most successful commentators says on this, the angler might reject "the unclean minnow."—Now the minnow has both fins and scales. The truth being, that here the distinction is not limited to fishes, but clearly includes the other families named. If to fishes, not more than two of the group which are naked, finless, and scaleless, occur, and that rarely in the waters of the great sea, or in the Nile, a river with which the people were at that time familiar.

This closeness of observation includes other phenomena, such as ocean current (Acts xxvii. 41); islands, (Ezek. xxvi. 18); ocean valleys (Psalm civ. 6); appearances such as these we see in the track of a vessel—"He maketh a path to shine after him, one would think the deep to be hoary" (Job xli. 32); and the variedly interesting phenomena of evaporation—"All the rivers run into the sea; and the sea is not full; unto the place from whence the rivers come, thither they return again." (Eccles. i. 7). The same truth is implied in the highly figurative references in Ezek. xlvii. 8-12.

Regarding it from the figurative point of view, another class of highly interesting passages comes before us. "The wicked are like the troubled sea" (Isa. lvii. 20).

The righteousness of the revived people of God, ever ready to answer heavenly impulses, is said to be "as the waves of the sea" (Isa. xlviii. 18). The four prevailing political systems which Daniel described are represented as coming up from the sea (Dan. vii. 3). When the prophet Micah sought to impress on the people how thorough the putting away of sin is, from all those who go with it to God, he said, "Thou wilt cast all their sins into the depths of the sea" (Mic. vii. 19). In language of great beauty, the reports of the coming up of enemies against Damascus and Hamath, are compared to that weird sound to which all have listened, who have stood alone in the darkness of night on the shore—"They have heard evil tidings; they are faint hearted; *there is sorrow on the sea*, it cannot be quiet" (Jer. xlix. 23)—an image unmatched by anything in ancient or modern poetry.

Passages might be multiplied on this topic; but turn to one other, in which He who made the sea and all that pass through the paths thereof, is set strikingly before us. The Father's promise to HIM is sure. Its fulfilment hastens as tribe after tribe acknowledge the power of his love—"He shall have dominion from sea to sea" (Ps. lxxii. 8.) "I will set his hand also in the sea" (Ps. lxxxix. 25.) His power over it is complete. Of old he used it for the destruction of a world. Ever since then it has had its spoils. Multitudes have found in it a watery grave, but the time is coming when his triumph shall be seen—"The sea shall give up its dead" (Rev. xx. 13). In the face of all this, do we not enter with our whole heart into the cry of the Psalmist, "Let the heaven and earth praise Him, the seas, and everything that moveth therein"? (Psalm lxix. 34).

CHAPTER VIII.

ATMOSPHERIC ADAPTATIONS.

Ancient speculations—Chemical constituents of the atmosphere—Mechanical combination—Natural formation of nitric acid—Its limitation—Control of personal will over natural law—Hegel—Quotation from Dr. Temple—Interference with continuous working of law—Illustrations—Sovereignty of Creator—Evidences of—Principle of gaseous diffusion—Biblical references to the atmosphere—Special illustration of Jonah iv. 6-8.

THE atmosphere supplies another series of interesting illustrations of the wisdom and goodness of God, in those general adaptations or adjustments to which we now turn. Whatever else we may miss in the speculations of the ancient physicists, we are seldom disappointed on the score of the highly poetical character of many of their theories. Left to grope in the dark after the Truth, the knowledge of which was so often made, not the dream only, but the bold, sustained, self-denying, and earnest endeavour of their lives, their imaginations were ever ready to make up for what observation fell short of, and what, in the absence of information above their own, was only a wide, dark, dreary waste. But their guesses at truth often surprise us. *Their* imaginings pique *our* curiosity, and we constantly ask what is implied in this theory? what had these old cosmical speculatists in view when they came boldly out with this hypothesis, or that? Are we to translate their language into modern notions? Are we to accredit them with sounder

views than is generally done, or are their speculations only dreams of ill-informed men—light imaginings, as far from the mark of science as the men themselves were from the knowledge of absolute, infallible, eternal truth? Be this as it may, some of their views on the question now under consideration are marked with great beauty. One of the saddest chapters in the history of our race, is that which chronicles the aspirations of those men, who so often, in the speculations of truth-loving minds, reached the very edge of the knowledge of that world of eternal realities which, in these last days, has been so fully opened up to us.

“Air,” said one of these men, “is vital—a soul, living and intelligent.” “It is soul eternal and imperishable; a substance endowed with consciousness.” Nothing short of this vague and most exaggerated notion could give even a distant hint of what they held the atmosphere to be. They felt its presence; they saw the dependence of animal life and vegetation on it. It filled their bosoms as if it were itself life. It fanned their cheeks in summer; it brought with it healthful energy in winter. Is it not, then, perennial, divine? Was it not more than—

“The vague sighings of a wind at even,
That wakes the wavelets of the slumbering sea,
And dies in the creation of its breath,
And sinks and rises, fails and swells by fits”?

Science touches these “light imaginings,” and they melt like snow-wreaths in warm sunlight. But beauty is not lost. The ideal gives place to the true; and modern enlightenment finds the atmosphere which surrounds the earth full of evidences of the wisdom, goodness, and love of the Creator. A lengthened treatise would

do but scant justice to this subject. We must limit our remarks to one or two facts connected with the composition of the atmosphere.

If we take 100 parts of air by weight, this, leaving out of view traces of carbonic acid and ammonia, gives us oxygen and nitrogen in the definite proportion of 23 of the former and 77 of the latter. This is vital air. All the varied phenomena of animal life and of vegetation on the surface of the globe, are the expression of the air's life-sustaining power. Yet there are other five substances which contain the same elements, and which are yet deadly poisons. These are nitrous oxide, nitric oxide, hyponitrous acid, nitrous acid, and nitric acid. If you take 100 parts of each, you have the following properties of oxygen and nitrogen :—

1. Nitrous oxide..... = O. 36·40 + N. 63·60
2. Nitric oxide = O. 53·33 + N. 46·67
3. Hyponitrous acid = O. 63·20 + N. 36·80
4. Nitrous acid = O. 69·60 + N. 30·40
5. Nitric acid = O. 74·10 + N. 25·90

In each of these the vital elements, the true life-supporters, have entered into chemical combination, have gone together in such a way as to form, by combining, other well-defined substances. The oxygen and nitrogen become nitrous oxide, nitric oxide, and so on, according to the proportions in which they meet. In the atmosphere, however, they are not *chemically*, but *mechanically* combined. There is no loss on the part of any one of them of its original determinate form and properties. It is here we see adaptive mind. The adjustment of the atmosphere to the great end and purpose of sustaining life, betokens a present, ruling, and beneficent One. The tendency in the elements to

combine chemically is arrested, and, by this mechanical combination, that which, otherwise, would have acted as a deadly poison becomes the true supporter of life.

Again: atmospheric air is diffused by a natural law all over the globe, meeting the lungs of the animal and the leaves of the plant; but the other substances, just mentioned, with one exception, are not natural products at all. They are the fruits of man's science—the products of the laboratory. As to the exceptional substance, its presence in nature, the mode of its isolation, and the control to which it yields, open up to us other illustrations of the presence of the great, all-wise, all-good, and almighty Lord. As man in the laboratory, by processes more or less complicated, combines chemically oxygen and nitrogen to make nitrous oxide and the like, so, in this case, does the natural electricity beheld in the sudden lightning-flash. It urges them into combination in the proportions which result chemically in nitric acid; but bounds are at the same moment set to this. It is confined to the neighbourhood of the lightning-flash. It is not permitted to extend throughout the entire volume of the atmosphere, influencing it in all its parts. In such a case life would be impossible. Even that which is generated soon loses all power to injure life, by being widely diffused; while, at the same time, vapours are evoked from the soil which hasten to neutralise its influence, even at the points where it has been generated. Thus in this ever-prevailing action of a system of divine checks and counter-checks, the Creator witnesses everywhere to his own overruling presence and special care. But while this is the case, do we not see what tremendous powers he has always at his command, and

what giant forces wait in his presence, ever prompt to do his bidding? The very winds are his messengers, and the flames of fire are his ministers.

We have throughout these discussions in regard to general adaptations—adjustments other than what meet us when dealing with individual parts of organism—given much prominence to phenomena illustrative of the presence of a personal will in creation, but have deferred the statement and illustration of the control of Will over Law till this point. After noticing some of the Biblical references to the atmosphere, we propose to enter on subjects of some delicacy and difficulty. Into these it is necessary that we should carry well-grounded and intelligent views regarding this question of direct sovereign control. Reference is made to this subject now, because, as will be seen, much light is shed on it by phenomena associated with the atmosphere. Moreover, great uncertainty manifestly prevails even among educated men on this point. Many are swayed by the last view they have heard expressed, or the last work they have read. But here, as in all other questions which, rightly or wrongly, have had important theological bearings assigned to them, it is of much moment that all should have a decided and well-grounded opinion.

In all inquiries in which, so-called, ever and evenly working natural law bulks largely out, two aspects of thought and speculation will show themselves, according as the natural bias of the student may carry him. On the one hand, some will see a principle only, ever acting in unvarying, well-known, and easily definable methods; while, on the other hand, many will be disposed to make little of this, and to content themselves

with giving constant prominence to the direct working of a Divine and sovereign will. In the former case, you have men enamoured with the dim, the remote, the abstract. In the latter, you see constant yearnings after a person, and the presence of a strong emotional nature leading to love, to worship, to service. What is wanted here is such knowledge as shall reveal the blind uncertainty which must ever characterise the action of principles when dissociated from the rule, restraint, and limitation of personal Will, and at the same time, individualise and define the person towards whom the longing goes out. The importance of such knowledge will be manifest, if we remember that there is a third party, who hold it their peculiar calling to guide the other two. This is made up of highly accomplished men, ready to express great value for the idea of law, and equal value for the recognition of individual will in the application and working of this law, but who so regard both as virtually to take away what strength is in them. In their view, the principle cannot turn aside from its inherent characteristics, nor can the person rise above an unchanging necessity supposed to belong to him. Thus, again, we have modern thought, modern enlightenment, and the so-called philosophy of science, seeking to put all power, all force, and all personality under an iron fate, which differs from the old heathen *fatalis vis* in nothing but the dress in which it is presented to us. As the ever-living fire of some of the oldest materialists was self-enkindled, so *this* kind of power is self-derived, and yet incapable of variation, of halting, of deviation. The whole thing, indeed, reminds one of Hegel's noted dictum: *Seyn und nichtseyen ist das*

selbe—"Being and not being are the same." All this is absurd enough, but it has its charms for certain minds; and the power to speak about it cheats men into the belief that, in doing so, they are clearing up the mystery of being, and shedding trustworthy light on its manifestations!

The form which this assumes when dealt with under the influence of certain aspects of so called Christianised thought, is suggestive. To all intents God is banished far off. The only personal concern which he ever took in this world and in man is associated with sovereign purpose in a remote past eternity. "The fact is," says Dr. Temple, "that one idea is now emerging into supremacy in science, a supremacy which it never possessed before, and for which it has still to fight a battle; and that is the idea of law. Different orders of natural phenomena have in time past been held to be exempt from that idea, either tacitly or avowedly. . . . But the steady march of science has now reached the point when men are tempted, or rather compelled, to jump at once to a universal conclusion; all analogy points one way and none another. And the student of science is learning to look upon fixed laws as universal, and many of the old arguments which science once supplied to religion are in consequence rapidly disappearing. How strikingly our view is altered from that of a few centuries ago, is shown by the fact that the miracles recorded in the Bible, which once were looked on as the bulwarks of faith, are now felt by very many to be difficulties in the way; and commentators endeavour to represent them not as interferences with the laws of nature, but as the natural action of still higher laws belonging to a world whose phenomena are only half

revealed to us." He adds, "If law be either almost or altogether universal, we must expect God to be manifesting himself not in individual acts of will, but in a perfection of legislation rendering all individual action needless." Now if God be thus isolated from his own laws, if he cease to have personal control over them, we do not see how we can escape the inference, that Providence is nothing more than law expressed in the form of "rigid mechanical action." Yea, we do not see how one can fail to conclude, that man is a law unto himself, as one separated from the very idea of the presence of God and independent of constant personal control.

Indeed this has come to be, very much, the case. Many readily receive the statement of the presence of personal will, who hasten to destroy this acknowledgment by becoming again "a law unto themselves." They thus receive as divine, as above nature, only what finds an echo in their own minds. This or that, it is said, consists with the, to me, well-known character of the originator of LAW, therefore it must be true; or, it does not harmonise with my views of him, therefore it must be false. But this is just the repetition of a very old deception. The Greek sculptor, under the best aspirations of his nature and of his nation, pictured to himself ideal strength, beauty, and grace. When he had transferred his thoughts to the stainless marble, he gave to his countrymen the statue, and both he and they worshipped the ideal man as God.

Now it is well known, that many of the ablest students of science work at present from this point of view. They refuse to admit interference, control, the

action of individual will. But on this assumption miracles would be impossible. Phenomena so named, would only be the action of laws belonging to a world with which we have little acquaintance. Are there any facts connected with the composition of the atmosphere fitted to lead to widely different conclusions? Is there anything to show us, that while this principle of law is indeed great and influential, it is, nevertheless, controlled, yea, interfered with by a power yet greater?

Prominence has already been given to the evidences of interference with the continuous succession of the stratified rocks. Indeed, our present classification of geological epochs implies such interference. Laws had been silently acting, and in their action producing tremendous results. Worlds had been brought into existence more than once—worlds stocked with teeming organisms; but each epoch had its limit. The grand march upward has again and again been suddenly arrested, for not one chaos only, but many, may have darkened the face of the earth, and hid it from the glorious sun. Now, associated with these cosmical changes, which determined the limits of epochs and revealed the power of the Almighty, were phenomena which have close bearings on many of the questions agitated in regard to the true beginning of the present epoch. For example, it is found that fossils, first met with in one great division of rocks, instead of perishing at the close of the epoch represented by them, are carried upwards, passing sometimes not only into the overlying series, but through it to others still higher up. Thus the pretty little bivalve *brachiopod* *Lingula* ranges from the lowest Silurian up to the comparatively recent coralline crag,

an upper tertiary deposit which comes very near the glacial epoch itself. The corals *Favosites* and *Heliolites* appear in the Lower Silurian, and survive that period; the former passing up to the carboniferous, the latter stopping at the Devonian. Among the gasteropodous mollusca, again, while *Holopæa* and *Maclurea* come and go with the Silurian, *Enomphalus* and *Murchisonia* survive it; the former being continued to the Trias, while the latter stops short at the Permian. The genus *Turbo*, again, had its representatives in each of the epochs.

The same line of remark might be followed in connexion with all the well-marked fossils of the different formations. The *Lingulæ*, which are still to be met with in tropical seas, are frail organisms. Their shell is of a thin, horny texture, ill-fitted to stand much knocking about; yet we find that in all geologic time this species had a place in nature, and it holds that place still, for it continues to be met with in shallow water on the coasts of India, the Philippine Islands, and Australia. Is it likely that our present species are lineally descended, without any break in the genealogical line, from those of the lingula beds of the lower Silurian? Few, we suppose, possessed of even a very little knowledge of the phenomena of physical geology, and with the forces which have been at work in bringing about the changes from one period to another—forces which even the extremest quietist must recognise in connexion with the unconformable character of rock masses and the like—would venture to answer affirmatively. Whence, then, the recent species? They have been created, introduced when they existed not. They might have been preserved, had the

Creator seen meet, from the time of their first appearance near the foundation of the world, but the phenomena referred to show that they were not. Well, if we are shut up to the acknowledgment of creative action here, why not acknowledge it at every point at which we find the forms of one epoch carried on to another? Yea, why ask us to confess, that the large percentage of certain very low forms of tertiary life, which corresponds with recent ones, could not have been realised at this point of the history of our earth, as, say, the *Lingula* was? If we must give in to the presence of creative power at one point, we may as well do it at ten thousand. But it would have been waste of power, say some, to re-create what had been before. Admit this principle and see where it would land us. Would it not compel us to own, that we had come to believe an omnipotent One *could* waste power? But the result was not worthy of such an act! Was Jehovah's interference with well-known laws, through his servant the prophet, when the axe-head was made to swim to the surface of Jordan, answered by a result worthy of the means? Of course, many very wise men—those who know so much as to imagine that they can judge all things—would turn away with scorn or with pity from a believer in this incident: but we put the matter thus, that Bible readers may see the danger of slipping into erroneous modes of thought, which, yielded to, sooner or later lead far away from the light of faith, and slope sharply down into the dismal darkness of unbelief.

This brings us to the point we had in view,—the illustration of the sovereignty of the Creator over his creatures—the control of Divine will over well-

known laws—even God's power to interfere with these as he wills, and at his pleasure. But what would be the result, you ask, if you admit the active interference of independent personal will in this sovereign way? Does not interference at one point imply influence over all? This may or may not be. It may, however, be granted when we remember that the interference is that of One all-wise even as he is all-powerful. Confusion might result if God were as man. Theorists first determine that it must be so, and then they urge their objections.

While these remarks have important bearings on the discussions regarding the antiquity of man, they may also be illustrated from those phenomena of the atmosphere we have been considering. Take the following question:—If the constituents of the atmosphere are not chemically combined, but only mixed, and if the specific gravity of oxygen is 1.1057, while that of nitrogen is only 0.972, how does not the heavier arrange itself below the lighter, or at least refuse to mix with it at all? We speak of the law of gravitation as universal. We should, therefore, not have an atmosphere whose constituents were thus mechanically mixed, but one in which they were mechanically stratified—a bed of oxygen topped by one of nitrogen. Now just as absolute pure water—water whose symbol is H_2O —pure in the sense of having no extraneous substance mixed with it, is useless, so the gas which we name the life supporter would be fatal to life if *it* only were inhaled. And, indeed, if the earth were thus surrounded with a layer of oxygen, the present order of nature would, in a short time, be in ruins. But all this is avoided by the simple but direct interference of the Creator.

Without suspending his great law, he puts these gases under another law, which neutralises the general one, *in so far as they are concerned*. This principle of modification is known to chemists as that of *gaseous diffusion*, a principle which is constantly at work in regard to gases which have no tendencies to seek chemical combination. The action of this diffusive power is most interesting, and all the more so that it is in direct opposition to the law of gravity. For example: if two bottles containing gases which do not act chemically upon each other at common temperatures, be connected by a narrow tube and left for some time, these will be found, at the expiration of a certain period, depending much upon the narrowness and length of the tube, uniformly mixed, even though the gases differ greatly in density, and the apparatus has been arranged in a vertical position with the heavier gas downwards. Oxygen and hydrogen can thus be made to mix in a few hours, *against* the action of gravity, through a tube a yard in length, and not more than one-quarter of an inch in diameter. If two such gases were put into a vessel, divided by, say, plaster of Paris as a wall between them, diffusion would at once begin, and continue till the mixture was perfect.

But even this diffusive power, which is thus used to modify a general law, is itself under definite control. It has been proved that there is a fixed relation between the rate of diffusion and the density of the gas. The diffusive power varies inversely as the square root of the density of the gas. Thus, if one-half of the vessel were filled with hydrogen and the other with oxygen, it will be found that four cubic inches of hydrogen will pass into the oxygen side, while

only one inch has passed into the hydrogen side. Now the densities of these gases are as 1 to 16; and their relative rates of diffusion will be inversely as the square roots of those numbers, namely, as 4 to 1. A law somewhat analogous to this is brought into action in the formation of ice. By this modification the frozen water is kept on the surface, while that below is kept fluid, at the maximum density of 40° , and thus continues fitted for the preservation of aquatic life.

These illustrations, which might be multiplied and set in relations of the most deeply interesting kind, are given as examples, with the view of illustrating that personal control to which we have referred. True, it might be said—But is not this principle of gaseous diffusion itself a law? Granted; but then it is in direct opposition to another, which is wider and broader; and how shall we account for that harmony of antagonism seen so clearly here? How, but by tracing it to the interference and constant action of a sovereign will?

Another remark will bring us back to the point of digression. It is made with the view of associating the thought of a wise and beneficent provision with this diffusive power of gases. In breathing, the lungs are alternately filled and emptied: we take in the oxygen of the air, which acts on the venous blood, and part with carbonic acid to make room for the oxygen. But this is, as far as direct action goes, very much confined to the large air tubes; and, were there no other arrangement, the smaller vessels would all continue loaded with the elements of death. But the principle of diffusion presents the remedy. The healthy air taken into the larger vessels seeks to mix with the carbonic acid still

in those minute cells which terminate the bronchial tubes. But this results in the further expulsion of carbonic acid from the cells, as it had been already expelled from the great air passages. Thus God shows himself as the great Preserver of men. Thus, literally, in Him we have our being.

We have purposely limited our remarks here to the composition of atmospheric air, properly so called, with the view of illustrating by what simple methods He who wields all the forces of nature can bring about most remarkable results. Taking the chief constituents of air, what a striking contrast presents itself between the effects of these constituents when in mechanical combination, and their effects when chemically combined! Everywhere we see sovereign wisdom and will working in order to most useful and beneficent ends. I have not touched on the numberless phenomena of atmospheric currents, of clouds, mists, dew, and the like, all of which abound with illustrations of the manifold wisdom, goodness, and love of God. I am not willing, however, to pass from the last of these general adaptations without noticing some of the Biblical references to it.

Few things connected with the words of Scripture strike one so much as their pictorial force. Seldom do we meet with what is remote, shadowy, abstract. There is just so much of this as to satisfy the imagination, or to train it for the important influences it comes to have in the life of faith. The men and women through whom the Holy Ghost has spoken to the men and women of all time, speak plainly. Even their use of figurative language ever suggests the underlying truth, generally when read only for the first time. Their

utterances are often deep, they are seldom dark. The allusions made by the writers of the Bible to nature show both how closely they had observed the phenomena of the external world, and how speedily intelligible great truths become when rendered in plain words, and associated with those natural appearances with which all are familiar.

As was to be expected, their references to the atmosphere almost all speak of its influences when in motion—when either as the gentle breeze it fans gardens of perfume, or as the storm it is fierce and strong, rough and tempestuous. Here again the starting point—the key verse—is far down the stream of time. “Prepare to meet thy God, O Israel. For, lo, he that createth the wind, the Lord, the God of hosts, is his name” (Amos iv. 12, 13).

The winds are, with great beauty, represented as laid up by him as jewels in a treasure house. Indeed few verses better express creative control, than those in which the winds, which make sport of man’s efforts and defy his power, are represented as thus ready to spring forth at God’s bidding from the quarters where they quietly sleep. The occasion comes, the thoughts of Jehovah find expression in his providence, and the ready servants leap suddenly forth; “He bringeth the winds out of his treasures” (Psalm cxxxv. 7). But this bringing forth is not for physical purposes only; it is for great moral and spiritual ends also. Take one illustration out of many. His people were on the edge of deepest and most brutish idolatry. They were ready to fall into a most degraded form of idol worship, when he offered to them that ever yearning heart of Fatherly Love: “Thus saith the Lord, Learn not the way

of the heathen." Their god is only "the tree cut out of the forest," silvered over, or decked with gold; "upright as the palm tree, but speaks not; the stock is a doctrine of vanities; but the Lord is the true God; he maketh lightnings with rain; he bringeth the wind out of his treasures" (Jer. x. 2-16). Thus, too, the words of Agar to Ithiel and Ucal, "He hath gathered the wind in his fists" (Prov. xxx. 4).

Scripture writers love to dwell on his sovereignty, as thus strikingly illustrated by his control over the winds. "He," says David, "commandeth, and raiseth the stormy wind, which lifteth up the waves" (Psalm cvii. 25). The ends towards which this sovereignty is directed, again illustrate how God wields physical forces in order to great moral results. Many passages show how the "wind fulfils his word." They are worth classifying from this point of view; but look at one of great beauty, in a portion of the word where a slightly altered rendering leads us into much interesting thought. That petulant prophet who had shrunk from his responsibility as "the mouth of Jehovah," had been caught in his flight by "the great wind, which the Lord sent into the sea," and had been set face to face with his duty. Nineveh had believed, and its doom, was delayed. Petulance became a cloud between Jonah's soul and his God. He was angry because the great Assyrian capital was spared. The Lord in his grace hastened to teach him the needed lesson, and to administer the richly merited rebuke. "The Lord prepared a gourd, and made it to come up over Jonah, that it might be a shadow over his head, to deliver him from his grief. So Jonah was exceeding glad of the gourd. But God prepared a worm when

the morning rose the next day, and it smote the gourd that it withered. And it came to pass, when the sun did arise, that God prepared a vehement east wind" (Jonah iv. 6-8). The gourd was prepared; the worm was prepared; the wind was prepared. Destined to a certain end, each was held ready till its time came. It is not necessary to suppose the plant (*Cucurbita maxima*)—a form noted for its rapid run or growth—to have shot up from the seed in a night. In a night, however, it must so cover the sticks of the arbour as to yield a shade from the sun. Nor is it needful to bring in a miracle to account for the worm. Isolating it for a certain purpose, and thus showing his personal and direct use of the very humblest of his creatures, the ravages of the vegetable-feeding grub were guided up to the moment of interest in regard to this one soul. Indeed, the presence of the worm thus gnawing the sap vessels, which cluster around the root of the stem, comes to shed some light on the rapidity of growth. If you cut any plant more than half through, you intensify its growth and fruitfulness. It, like higher forms, is under a law by which, when in danger, it hastens to bear fruit for the preservation of its kind.

Thus with the wind also. It was "prepared." Jehovah held it in his treasures, ready to carry out his will. But the word "vehement" is full of meaning. In the margin our translators have rendered this adjective by a word which at first sight seems in marked contrast with "vehement:" "The Lord prepared a *silent* wind." Here, as usual, they show what wonderful acquaintance they had with the varying shades of meaning so often met with in Hebrew words, especi-

ally in such as sprung out of the people's desire to give graphic expression to natural phenomena. The import of the expression may be indicated thus:—While wandering in a wood, when scarcely a leaf could be seen trembling on its spray, you have been made to halt and listen as a faint, far-off, indistinct, hollow sound fell on the ear, and you remembered the sign—"the sounds of the Lord's going on the tops of the mulberry trees." The stratum of rapidly moving air, which had just touched the topmost twigs of the forest, descends. The breeze breaks among the trees. No more have you the distant moan: the wind rises into tremendous power, and howls through the woods. Saplings are torn up. Branches are broken from oaks which had stood a century. Alas for the withered stakes of Jonah's harbour! Alas for the spreading gourd in such a moment! So here, the wind had been held in silence till the morning should break, and the prophet should again need the cool shadow underneath broad clustering leaves. It was prepared. The moment came, and He who holds the winds in his fists hurled forth this one to sweep away the prophet's idol. Thus wither our gourds; but the Lord liveth!

These are only a few out of many purposes to which he directs his winds as his messengers. By them he maintains health in the atmosphere, or sends blights on man's blessings. He can use them for dividing the sea. He can make them the wings on which the devouring locust shall fulfil his curse, as his great army, or on which flesh shall be brought to nourish the thousands of Israel in the wild Arabian desert. At his bidding they raise the sea into waves, in order that the spiritual nature of men might be impressed as they saw the royal

feet of His own eternal Son walking on the billows, or heard his majestic voice rebuking the winds and the waves into a great calm. Enough: the theme might be far more fully illustrated, especially in connexion with the proofs of the acquaintance which the writers of Scripture had with many even of the more remote phenomena of the winds, and in connexion also with their use of those phenomena in a figurative way. In all we see Him "who bringeth the wind out of his treasures."

The adaptations on a large scale, which we have reviewed and illustrated, are only a few out of very many which might have been considered. Nevertheless, it is hoped that something has been done to show that there are rich fields still unworked in the department of natural theology, and the importance of such scientific attainments as fit us to walk in those fields, to work them, to gather up their treasures, with the view of presenting them to Him to whom the wise-hearted in the olden times carried the abundance which he had given them, that a tabernacle of witness might, in their day, be raised before the nations of the earth.

CHAPTER IX.

GENESIS AND SCIENCE.

Changes in the attitude of science to Christian thought—Quotation from Rev. Vernon Harcourt—Genesis i. and ii.—Scientific speculations—Interest of to intelligent men—Historical character of opening chapters of Genesis—Schemes of reconciliation between Genesis and science—Scheme of Dr. Chalmers—Scheme of Cuvier—Views of Hugh Miller—Geological classification of Edward Forbes—Laurentian rocks—M. D'Orbigny's arrangement—Review of Genesis i.—Unsatisfactory character of Hugh Miller's age-theory—Principal Dawson's views—A better scheme of interpretation and reconciliation—"Created and made"—"In the beginning"—Genesis i. not to be associated with geologic time—Importance of this view.

GREAT changes have come over the attitude of science to the church and of the church to science during the last thirty years. Enough has been done in several departments of natural science by theologians to beget, in the minds of scientific workers, respect for their attainments. But the change has told in another direction. Few are so bold as to regard the relative claims of the Bible and science as they were accustomed to do some years ago. In 1838, the Rev. Vernon Harcourt wrote: "Far be it from me to accuse the distinguished writers on geology of raising their voice against the declarations of Scripture: but being much dissatisfied with the feeble attempt which they have made to reconcile their theory with the narrative of the Deluge in the Bible, and having reason to believe that

it has unsettled the faith of many, I conceived it might be of service to religion to demonstrate, that if geological speculations are at variance with Scripture history, they are not less at variance with the united testimonies of all nations from the remotest time to which history or tradition extends; and consequently that if one or the other must give way, it is incumbent on geology to revise her conclusions, and, for her own sake, to modify them, *so as to bring them to agreement with a truth which is placed by other evidence beyond all dispute.*"

Few speak thus now. The statement is reiterated, until many come to believe it, that all the uncertainty is on the side of Scripture and none on that of science. But let us not be ashamed or afraid to appeal to the testimony of Scripture, as that which stands on foundations which have never yet been shaken. It is to be regretted that this appeal was made by Mr. Harcourt in a connexion which greatly weakens its force.

By way of introduction to the statement and examination of the question of the Antiquity of Man, I propose to review, from the literature of science touching Genesis chapters i. and ii., the scientific speculations which have gathered round the Scripture account of creation. The importance of the subject cannot be rated too highly. It is one, moreover, on which every man having any claims to intellectual Christian culture should have a decided opinion—an opinion which he can express clearly, and in support of which he can adduce valid arguments. To some extent, it is true, men who have had no instruction in the branches of science specially bearing on this subject must be content to learn from those who have. In their case, who-

ever, there ought to be such familiarity with sources of information, as to be able to appeal to them as the foundations of their opinions. It might almost seem needless to insist on this. But the fact is, that in no other question bearing on the relations between Bible truth and different branches of human knowledge does so much hesitancy prevail. A haze hangs around even the best known aspects of the subject, and darkness around many others. Intelligent men are found cherishing impressions, as uncertain as to origin as they are flimsy in their nature. The result being, that these questions are gradually shaping themselves into subjects of popular discussion, where there are no appeals to facts, and in which truth generally suffers. There can be no greater risk than for men ignorant of scientific facts, as scientific workers, to discuss any of these topics, from the point of view of impressions caught from reading popular works of a physico-theological kind. Such works may be invaluable when used by Christian men to strengthen their own faith, on the one hand, or to acquaint themselves with the literature of unbelief, on the other hand. But such works are useless if their authors do not possess science sufficient to a thorough discussion of the whole matter. Every minister, especially, should be able to guide his people on these subjects, able to carry light into the haze, grapple with the topics raised, and thus be a true leader and guide.

But the importance is not limited to this enlightenment of the popular mind. These questions raise issues of a most momentous kind. Suppose we were to assume that Genesis i. and ii. are not inspired history : at what point in the same book could we find that the principles,

on the application of which we get quit of these chapters, would not hold? So far as I understand these principles, they are as applicable to Genesis iii. as to chapters i. and ii. But, then, I do not exaggerate the question when it is affirmed that, in the opinion of many, the whole after Biblical record, touching salvation by a Redeemer, proceeds on the historical truthfulness of Genesis iii. We can make little of Calvary, if the events recorded in that chapter are not true—not historical. You might, indeed, allege, that that great salvation was in itself historical and true. But if so, there must somewhere be the historical record of the coming in of sin, for the taking away of which Jesus died. If this history is not in Genesis iii., where is it? If Christian apologists do not narrow the ground thus, it will ultimately be done for them. But not soon. No; the haze must compact into the “darkness which can be felt;” the imaginings must first be taken for truths, and the erroneous impressions allowed to settle down into beliefs, and then, when too late for themselves, the subject controverted will be narrowed to this terrible issue.

In the review and discussions which follow, I am anxious to avoid everything like a dogmatical spirit. It is understood throughout, that, whilst I give expression to my own personal convictions, there is room for difference of opinion, both as to the bearing of some of the scientific facts and the interpretation of some of the passages of Scripture referred to. If in any case the estimate of other inquirers should seem too sharply defined, the reader is asked to attribute it to the brevity of statement unavoidable in a work like the present.

With our knowledge of geology, it is extremely diffi-

cult, if not impossible, to understand the sensation produced among thoughtful, though unscientific men, when their attention was first called by competent geologists to the fact that there had been, not one creation only, but a series of successive creations. That described in Genesis, they were told, is not the only one. It was the latest, no doubt, but several had preceded it. It was to the state of feeling thus called forth among professing Christian people, that the first of the schemes for harmonising science and the Bible addressed itself. It would not now be profitable to enter into a full discussion of all the schemes of harmony. Two, however, must be characterised; one of which is specially associated with the name of Dr. Chalmers, the other with that of Hugh Miller. In 1853, Hugh Miller, while still under the influence of the Chalmerian theory, wrote:—"The ferns and lepidodendra of the coal measures are as little connected with the truths which influence our spiritual state as the vegetable productions of Mercury or of Pallas; the birds and reptiles of the oolites, as the unknown animals that inhabit the plains or disport in the rivers of Saturn or Uranus. And so revelation is as silent on the geological phenomena as on the contemporary creations—on the periods and order of systems and formations as on the relative positions of the earth and sun, or the places and magnitudes of the planets." Words like these from such a man show how deeply Chalmers' views had influenced him. Referring to Genesis i., Chalmers had said, "The first verse describes the primary act of creation, and leaves us to place it as far back as we may; and the first half of the second verse describes the state of the earth at the point of time anterior to the detailed operations of this

chapter." He thus supposed that an immense interval may have elapsed between the beginning and the introduction of the present order of things, sufficient to have permitted all the great ages of geologic time to have passed into eternity.

This view has still a strong hold on many intelligent men; and there is so much in its favour, even when regarded from the scientific point of view, that we should be slow indeed to attempt to displace it by characterising it as worthless, lest something far less satisfactory should at once take its place in the popular mind. It satisfied men like Buckland, Sedgwick, Hitchcock, and Fleming. What stronger testimony could be alleged in its favour? Waiving the objections which have been urged against it by those who have no belief in periods of general confusion and darkness, like that implied in verse 2, on the introduction of great epochs; and of such, too, as complain that the sequence of the words of Scripture is violently broken if you thus separate the first verse from those that follow—waiving these objections, our doubt about it rises from another quarter. It does not harmonise with the method of Biblical history. In no other historical narrative in the Scriptures do you meet with a statement which has no bearing on the facts detailed. Besides, the longer we look at it, the less likely does it seem that, if geologic time had been embraced in the inspired narrative, it would have been dismissed in this summary way. This consideration has, no doubt, greatly influenced men in the direction of Cuvier's hypothesis, namely, that the "days" of Genesis i., refer to immense periods.

A short time before his death, Hugh Miller left the Chalmerian position, and embraced the scheme

of Cuvier. His latest views are embodied in the "Testimony of the Rocks." "The conclusion," he says, "at which I have been called to arrive is, that for many long ages ere man was ushered into being, not a few of his humbler contemporaries of the fields and of the woods enjoyed life in their present haunts, and that for thousands of years anterior to even *their* appearance, many of the existing molluscs lived in our seas. The *day* during which the present creation came into being, and in which God, when he made the 'beast of the earth after his kind, and the cattle after their kind,' at length terminated the work by moulding a creature in his own image, to whom he gave dominion over them all, was not a brief period of a few hours' duration, but extended over, mayhap, millenniums of centuries." He adds, that the only part of the Mosaic record with which the geologist has to do, is that which records the work of the third, fifth, and sixth days, "the period of plants, of great sea monsters and creeping things, and the period of cattle and of the beasts of the earth." "All geologists," he goes on to say, "agree in holding that the 'vast geological' scale naturally divides into *three* great parts." In his usual clear and masterly way, he gives us the state of the question, and leaves us in no doubt as to his views. He believes that the Mosaic record of creation is not a literal history of events as they occurred, but the description of a series of pictorial visions as they appeared to Moses; that the *days* of Genesis i. are periods indefinitely prolonged, and that these periods collate with the geological classification of rocks; Palæozoic, or primary; Mesozoic, or secondary; and Cænozoic, or tertiary.

It will readily be seen that when Hugh Miller set

thus closely, side by side, the geologic and Mosaic records, he was willing to have his theory tested from this point of view. Do the geological periods harmonise with the Mosaic days? I think not. Even as to the general divisions, great difference of opinion prevails among geologists. Indeed, the divergence is so wide here, that, as yet, no theorist can be warranted in coming to sweeping and decisive conclusions as to the harmony between the periods of days in Genesis, and the great geologic divisions. The late Edward Forbes, one of the ablest palæontologists of his day, judging from the characteristic fossils of the different groups of rocks, held that the whole of the secondary should be joined to the tertiary, and he named this great series of groups *Neozoic*; thus limiting all below the Permian to Palæozoic, and leaving us only two great ages to collate with three immense periods held to be mentioned in Genesis!

But more: the very same phenomena which have led to these leading divisions, have ruled in determining smaller and subordinate ones. In studying, for example, some of the oldest rocks of Scotland, we have, first, those to which the name of Laurentian has recently been given, from their typical development in the basin of the St. Lawrence; second, above these, and not conformable with them, the Cambrian; and higher up still, the Silurian. On the ground of stratigraphical and lithological peculiarities, these rocks are classified as of different ages. Then turning to them from the palæontological point of view, it is discovered that the traces of rhizopods, forms of life lying at the very bottom of the zoological scale, which are to be met with in the lowermost division, cease

until we reach the very top of the Cambrian, and when we enter the Lower Silurian, zoophytes begin to prevail, such as graptolites, rastrites, and the like. Lower and Upper Cambrian, Lower and Upper Silurian, Lower, Middle, and Upper Old Red, are respectively linked together, because the strata in their subordinate and secondary divisions are conformable. Thus the varying forms of organic remains, and the appearance and structure of the rocks, really warrant the divisions, while the fossils of the lower interlace with those of the higher, through forms introduced for the first time in the lower. For example, of, say, 108 genera which come in with the Lower Silurian, 29 cease, and 79 interlace with the Upper Silurian. The same line of remark might be followed with regard to the various formations in all the geological epochs. Now it is by the application of the same principles, that those wider generalisations are reached, which are named Palæozoic, Mesozoic, and Cænozoic, respectively. Such wide divisions are provisionally accepted as of value, from considerations of convenience in working and classification. They are of no value in any question of important controversy in which positive certainty and exact truth are sought. They are equally valueless so far as any attempt goes to collate the days of Genesis with the periods of geology.

If, in the classification of rocks, well-defined divisions are sought for other than working purposes—for the discussion of physico-theological questions on which men are at issue—let them be made. The result will be very different from that obtained by the advocates of the “age theory.” M. D’Orbigny’s arrangement would probably be found nearer truth than any other yet

proposed. This able palæontologist held, that instead of three great periods, a rigid, and at the same time wide examination of fossils, warranted the conclusion that well-marked evidence has been preserved in the fossiliferous strata of at least 29 distinct creations—periods far separated from each other, by intervals during which numberless species disappeared, and at the close of which others were introduced for the first time. In this light, again, the theory referred to will not stand the test of science.

Then what as to its agreement with the Word, when read in the light of science? Here its unsatisfactory character is even more marked. Let us look at the Biblical account of the third, fifth, and sixth day's work. In doing so, the question as to the meaning of the word *day*, whether it was a period of twenty-four hours, or one of uneven duration, need not be raised.

The narrative of Scripture is in the following words :

“And God said, Let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit after his kind, whose seed is in itself, upon the earth : and it was so. And the earth brought forth grass, and herb yielding seed after his kind, and the tree yielding fruit, whose seed was in itself, after his kind : and God saw that it was good. And the evening and the morning were the third day ” (Gen. i. 11–13).

Farther on we have,—

“And God said, Behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree, in the which is the fruit of a tree yielding seed ; to you it shall be for meat ” (ver. 29).

Does it admit of even the slightest doubt that the Lord refers, in the 29th verse, to the vegetation of the

third day? But the third day, it is alleged, collates with the Palæozoic period; yet the vegetation of that day is here given for meat to man! More; it is quietly taken for granted, that a luxuriant vegetation is the manifest characteristic of the Palæozoic, or primary geologic period. But how stands the matter? There are about 900 species of plants known to have belonged to the carboniferous system, nearly 800 of which are cryptogams, as mosses, ferns, and the like, but we have at least 400 zoophytes, 236 echinoderms, 220 crustaceans, 1,907 mollusca, 307 fishes, and 7 reptiles, or, say, 3,080 remains of specific forms, as against 900 plants. With such facts before us, are we not entitled to reckon the great excess of animal life over that of plants as a leading feature of the Palæozoic epoch? How can this fact of numerical abundance of animal life be got over, if we seek for an age of vegetables to harmonise with the account of the third day's work.

The record of the fifth day's creation runs thus,—
“And God said, Let the waters bring forth abundantly the moving creature that hath life, and fowl that may fly above the earth in the open firmament of heaven. And God created great whales, and every living creature that moveth, which the waters brought forth abundantly, after their kind, and every winged fowl after his kind: and God saw that it was good. And God blessed them; saying, Be fruitful, and multiply, and fill the waters in the seas, and let fowl multiply in the earth” (verses 20-22).

Fishes, birds, and sea mammals, were thus the forms created on the fifth day, which is held to answer to the Mesozoic period of the geological record. But we have

seen, that above 300 fishes belong to the older period. The geological record thus anticipated the work of this day! Nothing has, as yet, been said of land mammals and of reptiles, but taking the Mesozoic as commencing at the bottom of the trias and ending at the top of the chalk, what do we find? Many new plants, zoophytes, echinoderms, crustaceans, mollusca, reptiles, and mammals appear, and make it quite impossible to collate the two records.

So is it, too, with the sixth day, on which all true forms of land life (with the exception of birds), with man at their head, are said to have been, for the first time, set among the living creatures of the epoch. When we turn to the geological record, we find, that not only had reptiles and mammals existed at the time held to harmonise with the fifth day of Genesis, but also that in the tertiaries we again meet with new forms which should have, on this theory, been confined to previous epochs. New plants, zoophytes, echinoderms, mollusca, fishes, and reptiles, are for the first time brought into being. But this is not all. It is clear that the orbs of heaven are represented in the inspired narrative as brought brightly out on the fourth day. There had been light previously, for, on the threshold of his glorious work, God had said "Let there be light." Now if we take this narrative as it presents itself to unbiassed readers, this diffused light was amply sufficient for the vegetation of the third day, but on the hypothesis of that day being an immense period, during which the vegetation of the coal measures was developed, we would be forced to acknowledge that such vegetation had grown without true sunlight. This, indeed, is the position into which the advocates of this

theory have been forced, and they speak of vegetation on whose leaves a ray of sunlight never fell! Some time ago an antholite was discovered in the upper coal measures, which Dr. Hooker says, "is the spike of a very highly-organised flowering plant in full flower." Who that knows anything of the dependence of such plants on sunlight, could, for a moment, receive such a view of the absence of sunshine when the carboniferous flora grew in luxuriance and beauty? The fact is, that the conditions under which it was realised were not very unlike what obtains in warm countries still.

I am not careful to pursue this kind of remark further. Much more might be added; but enough has been said to show, that the theory now reviewed has its strongest points in the imagination of those who still hold by it, and not in the facts of science. Perhaps, however, it would scarcely be fair to pass from the subject without a notice of the popular and, in most points, able work of Principal Dawson, of Montreal. "Archaia" is written in a fine Christian spirit, by a man of acknowledged eminence, both as a theologian and man of science. In sobriety of judgment, Christian tone, and absence of strong bias, it contrasts most favourably with the wild guesses, the constant desire to oppose revealed truth, and the one-sided science which, more or less, mark many works on the same topics. Principal Dawson has ventured into regions in which Hugh Miller would not have felt at home, and from which he has wisely turned aside. He felt it would not have been in his way to discuss knotty questions in exegesis, or to deal with difficult astronomical subjects, which any attempt to collate all the days of Genesis with the phenomena of the external world

would have implied. To this task Principal Dawson set himself, and, as the fruit of his investigations, he offers us the following complete scheme of harmony, of correspondence, between the geologic and Biblical periods.

BIBLICAL ÆONS.

THE BEGINNING.

First day.—Earth mantled by the vaporous deep — Production of light.

Second day.—Earth covered by the waters—Formation of the atmosphere.

Third day.—Emergence of dry land —Introduction of vegetation.

Fourth day.—Completion of the arrangements of the solar system.

Fifth day.—Invertebrates and fishes, and afterwards great reptiles and birds created.

Sixth day. — Introduction of mammals—Creation of man and Edenic group of animals.

Seventh day.—Cessation of work of creation—Fall and redemption of man.

Eighth day.—New heavens and earth to succeed the human epoch —“The rest (Sabbath) that remains to the people of God” (Heb. iv. 9; 2 Pet. iii. 13).

PERIODS DEDUCED FROM SCIENTIFIC CONSIDERATIONS.

CREATION OF MATTER.

Condensation of planetary bodies from a nebulous mass—Hypothesis of original incandescence. Primitive universal ocean, and establishment of atmospheric equilibrium.

Elevation of the land which furnished the materials of the azoic rocks—Azoic period of geology.

Metamorphism of azoic rocks and disturbances preceding the Cambrian epoch —Dominion of existing causes begins.

Palæozoic period—Reign of invertebrates and fishes.

Mesozoic period—Reign of reptiles.

Tertiary period — Reign of mammals.

Post-tertiary—Existing mammals and man.

Period of human history.

As many of the remarks made on Hugh Miller's scheme are applicable here, it will be sufficient to notice that of Principal Dawson in a very general way. Beginning at the bottom, we have an eighth day introduced, to embrace the prophetic period of the new

heavens and the new earth. Of course we are taken out of the sphere of science, unless, indeed, we should, with Hitchcock, proceed to illustrate one of the passages referred to, by attempting, at least, to show how geology teaches that there is fire sufficient in the earth's crust to set "the heavens on fire, and to melt the elements with fervent heat." But as the author does not plead for synchronism between this eighth day and any geologic period, we need only look to the other passage referred to, namely, Hebrews iv. 9, "There remaineth therefore a rest (σαββατισμός) to the people of God." It need scarcely be shown here, how singularly inappropriate this reference is. Every one who has read the passage thoughtfully, knows how far from the mark the popular impression as to this text is. God had promised to Israel the Canaan rest, as he had given before to the patriarchs the seventh-day rest. Neither of these was complete and satisfactory so long as it was isolated from another, even the rest of the soul in the Lord Jesus Christ, believed in and received as the eternal Son of God, the Saviour. Look, says the Apostle, at your highest privileges, as identifying you with a favoured people; yours, with them, is the rest which is associated with the memory of God's rest when he finished his creative work; yours, too, is the satisfaction that the promise was fulfilled to the fathers in the gift of the land. But there is yet another to which I wish to shut you up—"There remaineth therefore a rest;" enter into this. It is now provided for you by the coming of the Messiah, promised to the fathers. Believe on him; know, receive, and enjoy the true rest of the people of God.

The seventh day is held to synchronise with the period of human history. Much might be written on this

point; but, again, without entering into questions as to the meaning of the word day, the alleged difference between sabbath and seventh day, and the like, there is, to the Christian, this fatal objection,—the theory would destroy our sabbath. “Remember the sabbath day, to keep it holy. Six days shalt thou labour, and do all thy work: but the seventh day is the sabbath of the Lord thy God: in it thou shalt not do any work.” If the whole human period be the sabbath, the seventh day, how shall we not do any work therein? Yet it has been kept by man from the earliest times, as we know from the Holy Ghost himself. Men have rested from their sore toil of head and hand. They have entered into quietness and peace with the dawn of the sabbath, as the day of sweet content and delight, when they had been weary with the distracting cares and wasting labour of the week. Show us how we are to secure our sabbath before you ask us to accept this conjecture.

The sixth day is collated with the tertiary and post-tertiary periods. We do not see why the author has separated the Edenic from the human period, except that the Bible record demands that man should be associated with the sixth day. Is this done with the view of leaving room for a lengthened period between Eden’s time of bliss and the expulsion from Eden? Some would save us all difficulty here, by proposing to make the tertiary epoch synchronise with the duration of the unfallen condition of man. A good deal has been made of this, but on asking what light Scripture throws on the question of time, the matter is very summarily settled thus:—“All the days that Adam lived were nine hundred and thirty years: and he died.” If, however, it be held that tertiary and post-tertiary make

one day, it must be held also that there was no break between them. The one linked naturally and smoothly into the other. But what says science here? We should expect to find the great majority of the tertiary forms of life associated with recent ones. If it be, indeed, affirmed that they had ceased to exist, then we have a break. Two well-defined periods are introduced, and the post-tertiary should embrace all the human period, just as the tertiary takes in the whole group of strata which stretches from the top of the chalk up to pleistocene. If this inference be rejected, it is fair to ask, how do you account for the marked difference between the great majority of tertiary forms and the present, or why was not man surrounded with the former and not by another group? Bear in mind that Sir Charles Lyell's classification was based on the percentage of alleged recent mollusca found in the tertiaries. Thus, in the lower beds, $3\frac{1}{2}$ out of 100 were held to resemble present molluscs; in the middle about 17 per cent.; in the upper about 35 or 40. Yet even as to these Sir Charles Lyell is now forced to acknowledge, "that some conchologists are unwilling to allow that any eocene species of shell has really survived to our time so unaltered as to allow of its specific identification with a living species." Indeed this remark is more or less appropriate in regard to shells found higher up. Even when generic forms are compared, much uncertainty prevails, but this is greatly increased when we deal with species. Then where are such modern representatives of the carnivora, as *Machairodus*; of the non-ruminants, as *Anthrotherium* and *Anoplotherium*; of the ruminants, as *Sivatherium*; of the pachyderms, as *Palæotherium*; of the *Mastodon* and *Megatherium*; or, indeed, of the forty or fifty genera

of mammals which came in with the tertiary, and perished ere it closed? If we look at species, we should have above 350 of mammals and about 30 of birds. Yet all these came and went, during a period which is here linked with the Edenic as part of the sixth day! They are easily satisfied who can receive this.

Looking at the mode in which Principal Dawson attempts to collate the third and fifth days with the geologic periods, we notice a wide divergence from Hugh Miller's scheme, or rather from Cuvier's scheme illustrated by him. The Palæozoic and Mesozoic periods are both associated with the fifth day, while part of the former is held to synchronise with the third day. Now, the forced and awkward character of this attempt must at once strike the reader. 1. The impossibility of finding a geologic period of vegetation to answer the Biblical statement, that the third day was distinguished by the creation of "the green herb," is acknowledged. The author does not name vegetation at all in this tabular scheme of geologic periods. 2. Had he done so, he must have made the creation of vegetable forms precede that of marine invertebrates and fishes. But palæontology meets this by a positive denial. 3. Taking a wider, and, at the same time, more correct view of geologic phenomena than Hugh Miller has done, he saw the necessity of bringing the geologic features which would answer to the Biblical fifth day together. But, in doing so, he dissents from the age theory, as stated by Cuvier, as interpreted by the late Professor Jameson, and as illustrated by the cunning hand of Hugh Miller. Thus, again, doubt, uncertainty, contradiction, mar every attempt at harmony.

Both the third and fourth days are here associated,

more or less, with the azoic period of geology. The name Azoic was given by Sir Roderick Murchison to all the rocks lying below the uppermost beds of the Upper Cambrian. This term is no longer appropriate to this extent. The Laurentian beds, which lie between the gneissose unfossiliferous rocks and many metamorphic strata, and the Cambrian of Professor Sedgwick, are now distinguished by what is appropriately named "the reign of the foramenifera." In making this statement, moreover, it is interesting to remember, that Principal Dawson has had a large share in the very discoveries which thus go against his attempts to collate the Biblical and geologic periods.

As regards the first and second days, there is little call for any lengthened statement. The hypotheses of a nebulous mass and of original incandescence are more widely and strongly controverted than almost any other general topics in natural philosophy and natural science; but their statement in this relation shows, that the author means by the matter which was created at the beginning, fire, air, and water. Given these elements, it would puzzle even an experienced chemist to shed light upon the next phase of their development—"the land, namely, which furnished the materials of the azoic rocks!"

We may thus dismiss these theories, and ask if there be not a better way? The answer to this will leave the ground cleared of many hindrances to a right estimate of the question of the antiquity of man. It will take us out of those cross lights which are far more painful, uncertain, and distracting than can well be imagined by any but those who have stood in the midst of them, longing, above all things, to get at the truth. Such as

have fought their way towards the pure light of truth, from the midst of the doubts and darkness associated with these topics, know that it is as grateful as ice on a fevered brain, or as cold water to a parched throat and burning lips, to find truth in a fully inspired record, and an infallible guide in Him of whom that record testifies.

The position, then, which I wish now to make good is this :—There is no reference to the geologic record in the first chapter of Genesis. That chapter is not a history, in any sort, of any order of things but the present. If this be true, we get quit of all those so-called schemes of reconciliation between Genesis and science, which are so fitted to puzzle and perplex multitudes, to whom the Bible has been given as a spiritual guide, and not as a source of controversy. Nor will the advantage be all with them. Science will reap profit too. When controversy arises, it will be settled on scientific grounds. It will be science against science, and not Scripture against science. We shall see the advantage of this position, when we get into the heart of the question of the antiquity of man, just as we shall ever feel its influence for good when, as disciples of the Lord Jesus Christ, we go into the world which he has created, to trace the workings of that same mind with which we are brought into fellowship in his own Word.

The Bible alone can help us to right views on this point. It is here, as in matters of doctrine, its own best interpreter. The candid and thoughtful will take the following suggestions in this spirit. If, as science advances, we are constrained to quit these schemes of reconciliation, let us not regret it; we are but putting off the rags of human wisdom to put on the seamless robe

of pure truth ; we are but quitting the open sea, where all is unrest, for the tranquil waters of a sure haven.

1st. Let us ascertain the meaning of the words "created" and "made." We are not entitled to conclude, that this verse is a protest against the materialistic and atheistic heathen hypothesis of the eternity of matter. That hypothesis is met most distinctly in many other passages of Scripture. Nor have we any question here about primary and secondary meanings of words—whether, for example, on their first occurrence in Scripture they are always used in their primary signification. All that we have to note, is the way in which these words are used in this chapter, or in some other portion of this book. "Create" is often used as interchangeable with "make." Thus, at verse 21, it is said, "God created great whales," and at verse 25th we have, "And God made the beast of the earth," etc. In Exod. xxxiv. it is used in the sense of "do"—"Marvels such as have not been done." Again, "made" has both the meaning of "create," as "let us make man," and of "prepare," "form," "fashion," as in Gen. xviii. 7, 8: "Abraham ran unto the herd, and fetched a calf tender and good, and gave it to a young man; and he hasted to dress it (literally, 'to make it')." And again, "the calf which he had dressed (literally, 'made')." So here: the existence of light previous to the second day's work implied the existence of a firmament, but that was to be prepared, brought fully out in lustrous beauty on the second day. Accordingly we are told that on that day "God made the firmament." There is nothing in these words opposed to the conclusion to which we are pointing.

2nd. The expression, "in the beginning," finds its

true interpretation in the Mosaic writings. It is a brief mode of intimating generally the particular facts afterwards to be presented in a fuller narrative. Here it stands for the six creative days, and is itself a part of the account of these days. “This month,” said Moses, “shall be to you the beginning of months;” an expression not only suggestive of the whole year, and intended to direct the mind of the people forward to its close, but one which intimates that the month was a true part of the year. “In the beginnings of your months,” is also a Mosaic phrase for an act which was to be repeated throughout the year. The word is elsewhere used with a meaning bearing even more closely on these remarks. Thus, men are represented as alive at the period which was the true beginning; as here: “From the beginning of the world, men have not heard.” “Hath it not been told you from the beginning?” “Have ye not read,” said Jesus, “that He which made them at the beginning, made them male and female?” Thus, then, we see the harmony between different passages of Scripture on this point. The words “In the beginning” (Gen. i. 1) collate with the word “thus” of Gen. ii. 1, and with the expression “in six days” of Exod. xx. 11,—

“In the beginning God created the heaven and the earth.”

“Thus the heavens and the earth were finished.”

“In six days the Lord made heaven and earth.”

“It has been very positively contended,” says Dr. Kalisch, an accomplished Hebrew scholar, “that the days mentioned in the Biblical record of creation signify periods of a thousand years, or of indefinite extent. But this imputed meaning is absolutely

against the usage and genius of the Hebrew language ; and the days of creation are really and literally periods of four-and-twenty hours." Nor should the first verse be separated from those which follow. It should be regarded as a brief but comprehensive summary of the six days' work.

It is to be kept in view that we are looking at the expression, "In the beginning," only as it is used in the Mosaic writings. We are not here called to do more. Reference may, however, be made to an often quoted passage in the Gospel according to John—a Gospel in which great and special prominence is given to the godhead of our Lord Jesus Christ. In chapter i. verse 1, this is very distinctly stated—"The Word was God." Then follow such declarations as these:—"All things were made by him; and without him was not anything made that was made. In him was life; and the life was the light of men" (ver. 3, 4). This ascription to him of the work of the veritable God is associated with the expression used in ver. 1,—*"In the beginning was the Word, and the Word was with God."* Now, even though we should understand the words, *"In the beginning,"* as suggestive of eternity, they may nevertheless be regarded as prefatory to the statements which follow immediately; for these have distinct and direct reference to Christ's everlasting standing as God. But there is nothing in the narrative in Genesis i. which follows the use of the words, *"In the beginning,"* that has any bearing on the eternity of God as the Creator, and the head of life and power. All this is, no doubt, implied, but still the account of creation (ver. 2-31) makes no mention of it. We conclude, then, that as in Genesis i., *"In the beginning,"* is the

preface to the record of creation which follows, so, in John i. it is the preface to the account of Christ's eternal Sonship, implied in ver. 1—4, and very fully illustrated throughout the whole of this Gospel. The narrative determines the scope and character of the preface.

3rd. In this view of the passage, we regard the word "heaven" as the equivalent of air or atmosphere, and the word "earth" as limited to the present order of things, and as having no reference to the geologic world. In the Scriptures "heaven" occurs in several widely different significations. For example, in the glowing description of Palestine (Deut. xi. 11) it is described as "a land of hills and valleys, and drinketh water of the rain of heaven." It is often spoken of as the place of God's special dwelling and glorious manifestation. Thus the frequent references to him as "the Father in heaven," etc. (Matt. v. 16; vi. 9; Mark xi. 26, etc.) In Psalm xix. it refers to the sun, moon, and stars—"The heavens declare the glory of God." In Gen. i. 1, it may be taken in the first sense. Accordingly, in ver. 8, it is said, "God called the firmament heaven." But this is even more evident from ver. 26, 28, where our translators have rendered the very word translated "heaven" in ver. 1, by "air"—"Let them have dominion over the fowl of the air;" literally, "over the fowl of the heavens."

Then, as to the word "earth," we are told that "God called the dry land 'earth'" (ver. 10). But that the word is used here in a restricted sense is evident from chap. ii. 1, "Thus the heavens and the earth were finished, and all the hosts of them." In this passage the sea is included, whereas, at ver. 10 it

is specially mentioned—"the gathering together of the waters called he seas." Sea, and lake, and river, are all embraced in the still more general term, "waters"—"And God said, Let the waters bring forth abundantly the moving creature that hath life" (ver. 20).

This line of remark might be followed throughout the chapter, and at every point the appropriate character of the words as descriptive of the present order of things would be manifest. We are, however, specially concerned with ver. 1, as what seems to us the natural preface to the subsequent account.

We do not see how we can resist the inference that the narrative of Genesis i. is one; in a word, that is, it has nothing to do with the geologic record, but that it is a true and literal history of the fact and order of the creation of the present forms of animal life and vegetation, and a record of arrangements, of adjustments in the heavens and on the earth, suited to the life with which the world was peopled. Getting to this point, one breathes more freely; the sky becomes clearer. In dealing with the phenomena alleged in behalf of a far higher antiquity for man, than we had been in the habit of assigning to him, there will be no occasion for frequent reference to the Bible. Of course we take up the question as believers in the accuracy of Biblical history, yet not prejudiced on that account, nor bigoted; nor indisposed to weigh facts and acknowledge their value, but the contrary, as we believe.

We believe truth would gain much if this view of the Biblical record were generally accepted. It is not put forward as a "scheme of harmony;" it is simply proposed to thoughtful readers of Holy Scripture as a ground of rest amidst many distracting discussions

touching the relations between the Bible and science. These discussions are likely to increase with advancing science. Notwithstanding the great progress of the natural sciences during the last fifty years, every unbiassed worker must feel that we have not yet got much farther than the threshold. The remembrance of this should make us cautious in theorising, and tender in our dealing with the theories of others. In each scheme of reconciliation glanced at above, some earnest men may have found rest. Their weak points have been referred to, in order that such as hold them might not be taken by surprise, when scientific objections are urged against them in the literature of unbelief.

The attitude of Christian thought to science insisted on throughout this volume, was recently exceedingly well stated by Dr. Pusey. At the "Norwich Conference" (1865) he said, "There appeared to be two opposite dangers which we had to beware in regard to any science touching upon Holy Scripture—first, an incautious adoption of any such discoveries as might seem to coincide with it; and secondly, a misapplied fear that any legitimate results to which any science might come could be adverse to it. In the one case we seemed, as it were, to be undermining our foundation and substituting sand for rock; in the other we gave the impression that we were ill at ease, whether our foundation were solid or not. . . . Truth seemed to suffer when supported by wrong arguments, and those not well grounded in the faith might say, 'Are you not mistaken in other cases also?' On our side we must beware of bending the sacred text to confirm the results of physical science, or insisting on our inter-

pretations as if they were certain to be true. People made a byword of those who condemned Copernicus, and we should act the same if we were too positive with regard to any given interpretation where the meaning was not illustrated by the whole compass of revelation. In faith, doctrine shed light upon doctrine. All the rays were concentrated by turns on each spot, and hence facts—although not always the main facts,—such as agreed were received; but statements, connected with them, if the meaning of those statements was not self evident, left us little whereby to give them as precise, or to enable us to say, ‘This meaning is as certain as Scripture is true.’”

Again, “As in the beautiful system of nerves, one prick at the extremity ran through the whole and might carry death, so it would be with the Gospel if it were possible. Attack after attack had fastened upon it, and people looked on wondering, as they did at St. Paul at Melita when he had shaken off the beast into the fire and received no harm. They who “were of the truth” knew that it had an invulnerable life, and could not be reached, for it was upheld by God. This then was their attitude towards any researches of any science—entire fearlessness as to the issue, awaiting it undisturbed, whenever it should unfold itself. Few things had been more mischievous than the attempt to square God’s word with facts imperfectly understood. Some of them remembered the weariness which it was to go through the attempts on historical grounds to explain the enrolment under Cyrenius or the account of Belshazzar; they were unsatisfactory because they were not true, and were said rather from the supposed necessity of the case than from any conviction. People un-

duly anxious about finding a solution took what came to hand instead of waiting for the truth, and owning 'I do not know.' Faith could afford this, for it was its own separate sphere—the home of its being. Physical science and faith were not commensurate. Faith related to that which was supernatural; science to things natural. Faith rested upon what was supernatural, science upon means natural, powers of observation, indication, combination, inference, deduction. Faith had to do chiefly with the invisible; science with this visible order of things. Science related to causes and effects, the laws by which God upheld his material creation. Faith related to God, his revelation, his word. Faith had the certainty of the divine gift. Science was the human certainty, the human reasoning. Faith was one divine, God-given habit of mind; it was one and the same in the well-instructed peasant and in the intellectual philosopher."

CHAPTER X.

MAN'S PLACE IN NATURE.

Four aspects of the antiquity of man—"After their kind"—Origin of species; Bible view of Scripture chronology—Appeal to the Bible—Speculations of M. de Maillet—Lamarck—Remark of Fontenelle—"Vestiges of the Natural History of Creation"—Darwin's "Origin of Species"—Huxley's "Man's Place in Nature"—Baden Powell's "Essay on the Philosophy of Creation"—Zoological features of man's place in nature—Carl Vogt's "Lectures on Man"—Drift of Huxley's work—Embryonic peculiarities—Materialistic character of Vogt's work—Man and the apes—Views of M. Gratiet—Influence of recent views on national morality—Hypothesis—Plurality of original simial stocks—Macacus and chimpanzee—Gibbon and orang—Mandrill and gorilla.

THE question of the Antiquity of Man assumes four aspects, according as we look at it from any one of four points of view. It is either Biblical, zoological, archæological, or geological. After what has already been said, we may, with a brief reference, dismiss the first aspect for a time, and deal, from the scientific point of view, briefly with the second, the zoological, argument for the higher antiquity of the human race. It is true that all these run into each other, and must be dealt with as having close relations, but it will give some clearness to the summing up, if we look at each by itself.

We see from a glance at Genesis i. that the words in which the creation of "the moving creature that hath life in the waters, the fowls that fly above the earth, the great whales, the cattle, the creeping things,

and the beasts of the earth " are referred to, differ wholly from those used in connexion with the creation of man. In the case of the beasts, it is repeatedly said that they "were after their kind." This expression implies, that while one group differed very widely from another, each group was made up of a number of species. The existence of specific character, as something fixed in the creative act, is clearly and most emphatically recognised in the Bible. The Scriptures thus decide the question of the *origin* of species. They do not, however, enlighten us on the *nature* of species. That is left for science to determine. The fact is stated, but nothing is said of the elements which enter into the fact. The naturalist is thus provoked to search, examine, observe, and classify, as the divinely endowed interpreter of nature, in order to show us what scientifically constitutes species. But when man is spoken of, we no more have such words as "after their kind." It is simply, "God created man in his own image, in the image of God created he him ; male and female created he them." We cannot misunderstand this language. It is plain, definite, unmistakable, and points to one species. The word of God nowhere warrants the idea of the existence of more than one species of man.

This theme is wide and, in the very highest degree, interesting ; but we are not now dealing with the question of the unity of the human race. Our theme is the antiquity of man, and not the blood relationship of all the families of man.

Again, as regards the Biblical view of the time during which man has been on the earth, we see that while some latitude for difference of opinion is admitted, it is really so small as scarcely to warrant us to attach

any importance to it. On this subject it matters nothing whether we take the date, say, from Adam to the birth of Abraham as 2,008, according to the alleged chronology of the Hebrew text; as 2,249, according to that of the Samaritan; or as 3,474, the period deduced from the Alexandrian edition of the Septuagint. We may take the last, as the longest, but we cannot push the date of man's appearing much, if any, further back, on the assumption that the book of Genesis is historical. The lists of the ages of the immediate descendants of Adam, and the period at which the Flood was sent on the earth, shut us up to the conclusion, that the early Biblical history supplies good foundation for the belief, hitherto current and common, that no great antiquity can be assigned to man. We put this consideration on the front of the statement of the question. Good, you say; but should you not have examined the scientific fact first? Would you not thus have come to an impartial judgment? Not more impartial than we may reach after setting out from the Biblical stand-point. If any hold, that belief in the historical accuracy of the Bible unfits for the discussion of scientific topics having Biblical relations, we do not now reply to such. But we believe science gains when its students work from this point of view. Is not her cry ever, "Truth first, truth second, truth last, always truth"? The more earnestly her alleged findings are searched into, the greater will be her advantage, for the more evident will be the truth. On all questions about which we are anxious to know the truth, we are in fairness bound to take into account historical references to them, even should these occur in a book whose history is not specially directed thereto. If on this question

I find strong and most distinct historic statements in the Bible, and if I have found Biblical history right and trustworthy on other topics, it would surely be unphilosophical, if not absurd, to ask me to shake myself free from Biblical impressions, in order to an impartial discussion. Truth, rather, demands that I should hold this ground until its insecurity is clearly and triumphantly shown.

A brief glance at the history of the subject now under notice is necessary. In 1750, M. de Maillet's "Telliamed" was translated into English, and for a season made a great noise. An extract from the table of contents will show its drift:—"Terrestrial plants that grow in the sea—Origin of land animals—Their resemblance to fishes—Easiness of their passage from water to air—Sea calves—Sea dogs—Sea men—Wild men—Men with tails—Men without beards—Men with one leg and one hand—The passage of men from the water into the air—Answer to some objections on this subject—*Conformity of this system with the book of Genesis.*"

M. Lamarck's work, "The Philosophy of Zoology," was published in 1809. The vagaries of De Maillet were, in it, presented in a more scientific form, and were illustrated with much power. Lamarck was one of the most accomplished men of his day. He was scarcely ever wrong in his observations of nature, and did almost as much as Cuvier himself to advance natural science. Wise in recording phenomena, he was a mere dreamer when he attempted to philosophise. His work was long held to have been bowed out of court with a broad grin by thoughtful readers. His speculations were subjected to open ridicule, and biting, bitter

irony, even by Sir Charles Lyell himself. But the abiding vitality of error had been forgotten. "Errors," says Fontenelle, "once broached among men, spread deep and wide roots, and cling about everything that supports them." The appearance of the "Vestiges of the Natural History of Creation," in 1844, in the very heart of advanced British thought, Christian enterprise, and broadly marked spiritual power, illustrated the sagacity of this remark. We were cast back on the crudities of De Maillet, and the wild hypotheses of Lamarck. Many were content to be so. Many more hailed the elements of discord thus cast into the midst of a great company, who were really and cordially working from the truth-loving point of view. It is worth while to note these things. But for the retrograde step of 1844, it may be asserted, we should not, for many years to come, if ever, have had Mr. Darwin's "Origin of Species," Professor Huxley's "Man's Place in Nature," or Sir Charles Lyell's "Antiquity of Man:" and Baden Powell's "Essay on the Philosophy of Creation" would have worked little damage. It is true, however, that certain aspects of the three first-named works had their germs in the state of science at that period, but these aspects would not have assumed the theological and Biblical bearings which now so strongly mark them, had not "The Vestiges" been published previously.

In dealing with the zoological features of this subject, this should be kept in view. It makes the present state of the question intelligible. It prepared the public mind for recent announcements on this point. It produced in society a taste for the discussion of such subjects, and the shock to Christian thought is now not so violent as

it would have been had this preparatory process not been going on.

Without going into the scientific merits of Mr. Darwin's book, we are justified in affirming, that its whole tendency has been to create an impression, that there is transmutation of species, and that man is but the last link, as yet, of a chain, whose earlier links clasped very different forms of life.

At this point, then, our subject assumes a well-defined form. Several working naturalists of great eminence and ability in the fields in which Lamarck was deservedly famous, have left them for the bypaths in which the fame of the Frenchman suffered damage and loss; and we are now called on to receive from them lessons in the philosophy of the natural history of man, and generalisations built on the debris of one-sided observations, partial knowledge, and isolated facts, as if all were past gainsaying!

Some, under the impressions now referred to, have asked, Does not the structure of the, so-called, man-like apes, exhibit so many points of resemblance to the physical structure of man as to warrant the inference that they were the ancestors of the human family? Others, again, under the power of this suggestion, have very eagerly caught at the discovery of skulls in pre-historic, or, as they allege, pre-Adamic deposits, which exhibit much divergence from the skulls of any of the families of men now living. Is not, it is asked, the divergence so great as to suggest, at least, the strong likelihood, that we have here the transitional link between man and the anthropoid apes? Now, while such questions, taken by themselves, are, we acknowledge, fitted to provoke a smile, yet, when regarded in the light of a cumulative

argument for the immense antiquity of man, the matter is much more serious and weighty. Professor Huxley's work, "Man's Place in Nature," the recently (1865) translated work of Carl Vogt, "Lectures on Man," and a number of articles in the same direction, in scientific periodicals, thus demand much more attention than they otherwise would. The drift of Professor Huxley's work is to set aside the distinctions between the orders *bimana* and *quadrumana*, which most naturalists accept, and to take us back to the Linnæan order *primates*, which included both of these. Arguing from structural and morphological features, he alleges that the embryo, ovum, or egg, is the same in all mammalia; that the posterior extremities in the apes are not prehensile organs, or hands, but true feet, as in man; and that there is nothing peculiarly distinctive in the brain of man when compared with that of the anthropoid apes. These positions are very ably defended and illustrated, as all who know anything of the author's great attainments as a comparative anatomist were prepared to expect. Having passed his facts in review, he says, "If man be separated by no greater structural barrier from the brutes than they are from one another, then it seems to follow that, if any process of physical causation can be discovered by which the genera and families of ordinary animals have been produced, that process of causation is amply sufficient to account for the origin of man. In other words, if it could be shown that the marmosets, for example, have arisen by gradual modification of the ordinary platyrrhini, or that both marmosets and platyrrhini are modified ramifications of a primitive stock, then there would be no rational ground for doubting that man might have originated, in the one case, by the

gradual modification of a man-like ape, or, in the other case, as a ramification of the same primitive stock, as those apes." There can be no mistake as to the author's meaning. Indeed, throughout he is almost needlessly lavish of statements of a very free and highly-pronounced kind, suggestive of his own honesty in braving the ridicule and censure of men as honest as he is, however, but who hold such opinions to be both materialistic and atheistic. Yet he does not leave us abruptly in the dismal dark. He offers us grounds of comfort, which, we imagine, few will be willing to take. "Thoughtful man," he says, "once escaped from the blinding influence of traditional prejudice, will find in the lowly stock whence he sprung the best evidence of the splendour of his capacities; and will discern in his long progress through the Past a reasonable ground of faith in his attainment of a nobler Future." Alas, for this hope! One looks back over thousands of years, and finds as noble, if not nobler, specimens of man than can be found in the present. Then, in all history there is not a shadow of proof, that our pithecoïd friends have got an inch nearer us, or have been able to take even one step up out of their sunken condition as brutes—dull, senseless, stupid, unthinking, unreasoning brutes. One fully appreciates the tendency of all this, and we are not to shrink from saying what we think of it, lest we should be held as under "the blinding influences of traditional prejudice."

But a word as to Professor Huxley's positions. He compares the ovum of the dog and of man, and can find no difference. This is denied by many able embryologists, and their testimony might with advantage be set off against his. But it has often seemed to me, that many

who have sought to save themselves from what appears to be the legitimate and necessary consequence of this assertion, namely, the destruction of everything like true specific differences in nature, by labouring to make out broad distinctions between the ovum of the dog, say, and that of the quadrumanous mammals, have missed the position of true strength. The statement may be held conditionally true, and yet its bearings fully controlled and directed. Suppose we were to fall back on the idea of plan, and to say, "It has pleased the Creator to associate the whole of the vertebrata by making them spring from a like germ cell"! The origin may be acknowledged to be similar; but how do you account for the gradually increasing difference as development proceeds? We see that with fish, reptile, mammal, and the highest of all mammals, man, all which you say result from the same beginning, the one never becomes the other. This, moreover, is a result so unerring, that in all history there is no record of a mistake. The reptilian egg has never fallen short of its end, and produced a fish; that of the dog has never risen higher, and produced a monkey. We lose nothing if we let Mr. Huxley take his own way here, and follow his own hypothesis. If all be alike at the outset, each is, nevertheless, put under an undeviating law. It must result ultimately in its development in a form "after its kind." This is all we care for; though, in making this admission, the question as to original difference is not given up.

The views of Mr. Huxley in regard to the hind limbs show how far a man may be carried in advocating foregone conclusions. The so-called hind foot he holds is not a true prehensile organ, yet it is notorious that the

foot is habitually used as such, more so, indeed, than the hands. The function it performs in these apes is to seize branches as they move from tree to tree; in this case, if not in all others, the function should be held to determine the nature of the organ. On this point, again, some of the highest anatomists are at issue with him. Indeed, even he is forward to acknowledge that there are fundamental differences. He says that these are "important enough in their way, the structure of the foot being in strict correlation with that of the rest of the organism in each case;" and he adds, "but, after all, regarded anatomically, the resemblance between the foot of man and the foot of the gorilla are far more important and striking than the differences."

Before referring to the brain, Professor Huxley says, "the differences between a gorilla's skull and a man's are truly immense." "No human cranium, belonging to an adult man, has yet been observed with a less cubical capacity than 62 cubic inches." "The most capacious gorilla skull yet measured has a content of not more than $34\frac{1}{2}$ cubic inches." These admissions he seeks to set aside by adding, that "the difference in the volume of the cranial cavity of different races of mankind is far greater, absolutely, than that between the lowest man and the highest ape, while, relatively, it is about the same." In like manner, when referring to the great difference as to weight between the brain-mass of man and that of the gorilla, he urges the same consideration, and does away with the force of the admission by suggesting, that as great differences obtain between one human brain and another as between that of man and the gorilla. This mode of dealing with organs and systems of organs is pursued

throughout his work. But no one will care to deny this. Does it, however, therefore follow that an anatomical case has been made out for the descent of man from the anthropoid apes? There would have been some weight in it had it been made clear, on the one hand, that as great differences of brain occur among adult gorillas as among adult men; and, on the other hand, that, once introduced, these become permanent and hereditary—new steps in the upward progress towards man. In the case of man it is notoriously the other way. Even in single families there are great varieties in the forms of crania, and the transmitting element often works backward, if one might so say. The small cranium of a parent is often replaced by one of maximum dimensions in his child.

Carl Vogt's work on man, just referred to, has already begun to attract a good deal of attention. Carl Vogt is known to all zoologists as a most enthusiastic and able naturalist. But so was Lamarck: so was Oken. The character of the present work will be seen when it is affirmed, that to the worst aspects of the speculations of these wayward workers, it adds, on almost every page, evidences of deep and intense hatred of everything through which Christian thought influences society. Perhaps it is better thus, than had it been marked by that homage to religious views which characterises some English works in the philosophy of science whose tendencies, however, are equally bad. The materialism is openly expressed here; the atheism is frankly avowed. Indeed, in the translator's preface many apologies are made in "excuse of the attacks made by him on theological dogmas." "If M. Vogt had been an Englishman," he says, "I

should certainly have highly censured a man of such profound and extensive views wasting his energies in attacking the opinions of theologians." To distract the reader as little as possible, some of the most filthy and blasphemous passages are kept out of the text, and a novel method of saving the student from them is had recourse to. They are brought together and printed in an appendix! The book is being widely circulated, and the eminent abilities of its author as a man of science demand, that it should be noticed by any one wishing to give a fair view of the present aspects of the great question now under review.

The translator says, "Vogt acknowledges that, to a great extent, he is willing to accept the conclusions of England's great modern naturalist, Charles Darwin; but, unlike many of that profound observer's followers in this country, he entirely repudiates the opinions respecting man's unity of origin, which a section of Darwinites in this country are now endeavouring to promulgate. The author's views on this point I hold, in the present state of science, to be especially sound and philosophical; and I hope that this work may help to counteract the inconsistent and antiquated doctrines now being taught by one of our government professors respecting the small distinction which exists between the members of the genus *homo*." "The ape-type," says Vogt, "does not culminate in one, but in three anthropoid apes, which belong to at least different genera. Two of these genera, the orang and the gorilla, must at all events be divided into different species; there are, perhaps, some varieties of them which form dispersive circles, like some around certain races of man. Be this as it may, this much is

certain, that each of these anthropoid apes has its peculiar characters by which it approaches man; the chimpanzee by the cranial and dental structure; the orang, by its cerebral structure; the gorilla by the structure of its extremities. None of these stand next to man in all points; the three forms approach man from different sides without reaching him." In support of this assumption he quotes Gratiolet, whose name is intimately associated with present zoological discussions on this question:—"As heads of three different series, these apes still preserve the character of the groups to which they belong, although they possess, if I may so express myself, common insignia of their high dignity." "No valid objection," continues Vogt, "can be raised to these deductions of Gratiolet, in the presence of the facts; but these facts prove our assertions, that the higher developed forms of different parallel series of apes approach man from different sides. Let us imagine the three anthropoid apes continued to the human type—which they do not reach, and, perhaps, never will reach—we shall then see developed from the three parallel series of apes, three different primary races of mankind, two dolichocephalic races descended from the gorilla and chimpanzee, and one brachycephalic descended from the orang; that descended from the gorilla is, perhaps, distinguished by the development of the teeth and chest; that descended from the orang by the length of the arms and light-red hair; and that issued from the chimpanzee by black colour, slender bones, and less massive jaws." Again: "It is just this plurality of characters which confirms us in our view. If the macaci in the Senegal, the baboons on the Gambia, and the gibbons in Borneo, could become developed into

anthropoid apes, we cannot see why the American apes should not be capable of a similar development! If in different regions of the globe anthropoid apes may issue from different stocks, we cannot see why these different stocks should be denied the further development into the human type, and that only one stock should possess this privilege; in short, we cannot see why American races of men may not be derived from American apes, negroes from African apes, or negritos, perhaps, from Asiatic apes. On examining the species of mankind and their history, we arrive at similar results." "But if this plurality of races be a fact, as well established as their constancy of characters, despite of the many intermixtures through which the natural primitive races had to pass—if this constancy be another proof for the great antiquity of the various types, for their occurrence in the diluvium, or even in older strata, then all these facts do not lead us to one common fundamental stock, to one intermediate form between man and ape, but to many parallel series, which, more or less locally confined, might have been developed from the various parallel series of apes."

This, to say the least of it, is very offensive, and would not have deserved to be noticed but for certain ethical relations it assumes. When stated as if it were the protest of science against antiquated theological, mind-cramping dogmas, it possesses, to many minds, some attractive features. Its early prevalence among many continental men of science soon bore fruits. Great numbers of the working and middle classes, on whom the prosperity and greatness of nations so much depend, were brought under its influence. That severance of the popular mind from the power of

the highest truths, involved in the reception of such degrading materialism, has worked sad havoc in some continental states. Where it prevails, social morality ceases to be regarded as having its foundations in eternal truth. It becomes no more than a congeries of conventionalisms, an explosive mass which the lightest sparks of lust and lawlessness may fire at any time. In this country the influence of the church of Christ is still owned in the regulation of manners, in the domestic constitution, and in the affairs of the state. Her testimony has tended to beget a comparatively healthy public opinion on the side of social morality. She has honoured the word of Christ, and, to the extent to which she has done so, an atmosphere of Christian thought has been thrown over all social morality, all educational enterprise, all active philanthropy, and all political effort. But let views such as those indicated by Vogt, and needlessly homologated by the Anthropological Society, prevail, and soon all this would cease. The way, then, to stem the tide which threatens to set in, is to look such speculations in the face; examine them, and point out their marked divergence from the path of true scientific inquiry.

The first thing that strikes one in looking at them, is the frequent repetition of the words "if" and "perhaps"—words which in no department of thought are so mischievous as in the philosophy of natural science. Hypotheses are stated by one man, and another comes to use them as if they were acknowledged facts, unchallenged, unquestioned. But no sooner has this been done, than a third, and generally a more numerous company, assign to these the rank of absolute truth. On the question now under consideration this is specially

true. Some of our leading naturalists now work and record their observations, as if the extreme antiquity of man were settled for ever and beyond all question; and many subordinate and second-rate workers seem to have discovered that their calling is to do little else than ring this in men's ears. Thus it has come to pass, that many, from whom better things might have been looked for, have fallen under the impression that what has so often been repeated must of necessity be true. They have not the skill to examine for themselves, nor the patience to wait till others do it for them.

Let us look at M. Vogt's "if" and "perhaps." The whole fabric of assumption in the preceding extracts hangs on them. These extracts, moreover, really contain the substance of his sixteen elaborate lectures. The point insisted on is a plurality of original stocks from which man is held to have sprung. Some have thought, that the Neanderthal remains should be regarded as traces of a primeval race which at one time peopled Europe—a race, as Professor Huxley seems to hold, which has survived, and is represented by the aborigines of Australia. Indeed, this hypothesis has, in part, been accepted by Vogt, to the great grief of his translator, who says,—“In Lecture X. it will be seen that the author has unfortunately accepted the wild speculation of Professor Huxley respecting the resemblance of the Neanderthal calvaria to that of the Australian.” But this is not allowed by Vogt to clash, in any way, with his favourite theory of a variety of pithecoïd or simial original stocks for the human race.

It will have been observed that Vogt's "if" and "perhaps" indicate, in a very loose way, that he has

come to believe the views of Gratiolet, on which the inferences quoted have been based. "On comparing the brain of the orang with that of other brains," says Gratiolet, "we are bound, on account of the size of the anterior lobe, the relative smallness of the posterior lobe, and the development of the superficial transition convolution, to place the orangs at the head of the gibbons and the *sempnopithec*i. The orang has a gibbon's brain, only richer, more developed, in a word, brought nearer perfection." "On comparing the brain of the chimpanzee with that of the true macacus, and specially of the magot, it is impossible for us to reject the analogies presented by this comparison. When, therefore, we put aside every preconceived theory, we are irresistibly led to the conclusion, that the chimpanzee brain is a perfected macacus brain. In other words, the chimpanzee stands in the same relation to the macacus and baboon, as the orang to the gibbon and the *sempnopithec*us." "The gorilla is a mandrill, just as the orang is a gibbon, and the chimpanzee is a macacus." These remarks will be understood when it is remembered that the gibbons (*hylobates*) are the long-armed apes of the East, and the *sempnopithec*i are the long-tailed and cheek-pouched monkeys of Asia. To this genus the sacred monkey (*S. entellus*) of the Hindoos belongs. *Macacus*, again, is the genus represented in Europe, on the rock of Gibraltar, as the Barbary ape; and the mandrill (*Papio mormon*) is a very large baboon, one of the *cynocephali*, or dog-headed, short-tailed quadrumana. Each of these is distinguished by such well-marked and clearly defined characteristics as to entitle it to the rank of a genus.

But these characteristics embrace many other peculiarities of structure besides cerebral ones, which are all

disregarded here. Other genera are left out of sight, through lying between the one chosen and the highest form to which it is linked ; and we are invited to believe that there has been a process of development from African apes up to negroes, from American apes up to certain American races, and from Asiatic apes up to certain Eastern races, of the same kind, after the same manner, and very much in the same degree, as what is here gratuitously alleged to have taken place when the mandrill, after various steps, became the gorilla, the Barbary ape rose to the chimpanzee, and the sacred monkey, "the metamorphosed prince" of the superstitious Hindoo, attained only the bulky dignity of the orang-outan; for, in the upward march as to body and bulk, there had been a downward one as to intelligence, the lowest brains exhibiting the highest psychical attainments ! Yet all this speculation has the ring of true science, and its authors seem to cheat themselves into the impression that, having come to believe in their own theories, all other men will hasten to the same conclusions. They are under a great mistake.

If the chimpanzee were once a macacus, the gibbon the ancestor of the orang, and the mandrill the original stock of the gorilla, how comes it that each now fails in ever identifying itself with the other ? How comes it that the so-called lower forms have in all historic time gone on repeating themselves by ordinary birth, and steadily refusing to pass upward to the higher ? In science, hypothesis is nothing when it is directly contradicted by facts, and theory is vain which cannot point to one well-authenticated fact in its support. We might with just as good warrant, if not with better, say, on comparing the

brain of the rat and the mouse, of the Scotch grouse and the capercailzie, of the jackdaw and the raven, of the European dipper and the blackbird, of the freshwater trout and the salmon, "it is impossible for us to reject the analogies presented to us by this comparison." In each case the analogy of brain would warrant the conclusion that there is no generic distinctions between these. The one was once the other; the rat a mouse, the capercailzie a brown grouse, the raven a daw, the blackbird a water ousel, and the salmon the common trout!

But, further, we are given to understand that no one anthropoid ape stands next to man in all points. The chimpanzee approaches him by the form of the skull and teeth, the orang by the characteristics of its brain, and the gorilla by the structure of its arms and legs. The geographical distribution of the first two might have allowed them to come together, that the one might give its skull and the other its brain as a contribution to the structure of the man, thus in the act of growing up *somehow*, but how the gorilla was to meet with them, and add to their gifts arms and legs for man, is puzzling enough, even from the geographical point of view. If man is to have any other origin than the one assigned to him in the Bible, let us not have the scheme of M. Vogt. Give us development from nothing to a monad, and from a monad to an oyster, or to anything else, far rather than this.

CHAPTER XI.

THE ANTIQUITY OF MAN.

Traces of man in ancient superficial deposits—Danish kitchen-refuse-heaps, or *kjökken-möddings*—Quotation from Sir Charles Lyell—Alleged antiquity of refuse-heaps—Extinct forms—Great auk—Lake or pile dwellings—Geologic aspects of the question—Cuvier's theory of the earth—Contemporaneity of man and the great extinct mammals—Review of facts bearing on the subject—Ox, deer, elephant, rhinoceros, hippopotamus, Irish deer, bear, hyæna, cat—Quotation from Dr. Falconer.

It is not likely that the world would have been troubled with Vogt's lectures, but for certain discoveries in superficial deposits which have recently engrossed the attention of scientific men, evoked sympathy from a numerous class, to whom everything opposed to Scripture seems ever welcome, and which have called forth the earnest animadversions of some students of theology. Few scientific subjects in modern times have taken such a strong hold on almost every class in the community. Nor is this interest confined to Britain. It is even more keenly canvassed in Germany and France than here. American theological and scientific reviews show that the deadly struggle raging there has not kept them from a strong interest on this subject. In India, even, the subtle intellects of a race just quickened into power by the reflex influence of western Christian thought, are employed in discussing the question of the Antiquity of Man. It is not unlikely that just where it may do

least evil, it will be most sifted, weighed, and an intelligent effort made to understand its bearings, while many may little regard it, who stand where its tendencies in unsettling old healthy beliefs, and in raising doubts as to the historical veracity of the Bible, are strongest. We have glanced at some of the zoological aspects of the question; others will come up as we regard it from the points of view of archæology and of geology.

The archæological aspects are highly important, and present many difficulties to the inquirer. Let us indicate the leading features of this branch of the subject. It deals with what is now generally known as the pre-historic era. Traces of man have been found in "refuse-heaps," or *kjökken-möddings*, as the Danish antiquaries have named them; in the remains of pile or lake dwellings, or crannoges, and in tombs or cromlechs, never, as it has been alleged, used in historical times. A very high antiquity has been claimed for the refuse-heaps and the pile-dwellings. The former are held to synchronise with the earliest part of the so-called stone period; the latter, rather with that of the early bronze and the later bronze and iron periods. "Scattered through the kitchen-refuse-heaps are flint knives, hatchets, and other instruments of stone, horn, wood, and bone, with fragments of coarse pottery, mixed with charcoal and cinders, but never any implement of bronze, still less of iron. The mounds vary in height from three to ten feet, and in area are some of them 1,000 feet long, and from 150 to 200 wide." The alleged great antiquity of these mounds is deduced, first, from the rude instruments found in them; secondly, from the distance of some of them from the sea-shore; thirdly, from their not having

been met with on certain coasts ; and, fourthly, from the presence of remains of certain species of animals which are known to have long disappeared from the districts in which they have thus left their traces. On the first of these arguments, Sir Charles Lyell remarks,—“The heaps are rarely placed more than ten feet above the level of the sea, and are confined to its immediate neighbourhood ; or if not (and there are cases where they are several miles from the shore), the distance is ascribable to the entrance of a small stream, which has deposited sediment, or to the growth of a peaty swamp, by which the land has been made to advance on the Baltic, as it is still doing in many places, aided, according to M. Puggaard, by a very slow upheaval of the whole country, at the rate of two or three inches in a century.”

The inference held to spring necessarily and naturally from this fact, is, that these refuse-heaps were once close to the shore, but that a peaty swamp has, since they were formed, intervened between them and the sea. Think, then, it is said, of the immense time which this swamp must have been in forming, and then conclude that the men who made the heaps had passed away before the peat began to grow ! Some, who have no pet theory to maintain, might, in their simplicity, believe that the presence of the peat determined where these ancient men would make their dwelling, namely, on the landward side of the bog.

But the shells ? Well, this is not the only difficulty ; for one might reply in turn, “But the bones ?” The answer to both would be the very natural one :—As the bones of land animals present in these heaps, when on the shore, show that the animals had been carried thither by the hunters, so had the shell-bearing mollusca

been carried inland by the fishers. If an immense antiquity is to be claimed for these, it must find a warrant somewhere else than in *such* facts.

“But,” continues Sir Charles, “there is also another geographical fact in favour of the antiquity of the mounds, viz., that they are wanting on those parts of the coasts which border the Western Ocean, or exactly where the waves are now slowly eating away the land. There is every reason to presume that originally there were stations along the coast of the German Ocean, as well as that of the Baltic, but by the gradual undermining of the cliffs they have all been swept away.” To this it might be answered, with equal fitness and point,—There are large portions of northern coast-line which have not been subjected to this wear of ocean, on which none of these kitchen-refuse-heaps have ever been found; and is it not in the highest degree likely, that they may have been likewise wanting in the districts now referred to? The possibility of urging such an argument reveals the worthlessness and the weakness of the hypothesis. Besides this consideration, many most important matters connected with the rate of this alleged encroachment of the waters of the ocean on the land, would require to be definitely determined before any use could be made of the alleged fact on such a question as that now noticed.

“Another striking proof”—we quote again from Sir Charles Lyell,—“perhaps the most conclusive of all, that the refuse-heaps are very old, is derived from the character of their embedded shells. These consist entirely of living species; but, in the first place, the common eatable oyster is among them, attaining its full size, whereas the same *Ostrea edulis* cannot live at present in

the brackish waters of the Baltic, except near its entrance, where, whenever a north-westerly gale prevails, a current setting in from the ocean pours in a great body of salt water. Yet it seems that, during the whole time of the accumulation of the shell mounds, the oyster flourished in places from which it is now excluded. In like manner the eatable cockle, mussel, and periwinkle (*Cardium edule*, *Mytilus edule*, and *Litorina littorea*), which are met with in great numbers in the refuse-heaps, are of the ordinary dimensions which they acquire in the ocean, whereas the same species now living in the adjoining parts of the Baltic only attain a third of their natural size, being stunted and dwarfed in their growth by the quantity of fresh water poured by rivers into that inland sea. Hence we may confidently infer that in the days of the aboriginal hunters and fishers, the ocean had freer access than now to the Baltic, communicating probably through the peninsula of Jutland, Jutland having been, at no remote period, an archipelago." In addition to the mollusca, remains of the bones of the urus, or wild bull (*Bos urus*), of the beaver (*Castor fiber*), the seal (*Phoca gryphus*), of the dog, and among birds, of the great auk (*Alca impennis*) and of the capercailzie (*Tetrao urogallus*) occur. Of these the urus and beaver are extinct in Denmark; the seal is extremely rare; and the great auk has perished within the last fifty years.

Now (1) as to the presence of the edible oyster, and the heaps themselves. Professor C. H. Hitchcock has pointed out, that "similar heaps are scattered along the Atlantic coast from Prince Edward's Island to Georgia. In both continents these heaps indicate that the oyster formerly flourished in abundance where it is now ex-

tremely scarce. The fact, however, does not necessitate a very ancient date for the accumulation of the rubbish-heaps, since in Maine we can prove that the oyster became thus nearly extinct within the time of the white population." At the present day there are tribes of Indians in British North America who form such refuse-heaps still; while, contemporary with them, there are others who have no such custom. Would any one, then, be warranted to conclude that these refuse-heap makers are greatly more ancient than the others?

As regards mammalia and birds, the whole question is even more uncertain. The urus, whose bones occur in great numbers, was alive in the time of Cæsar; and the auk, as has been remarked, only lately ceased to be met with. In 1828 Professor Fleming notes, in his "British Animals," that it "breeds occasionally in St. Kilda;" and adds, "breast and belly white. In winter, the brownish-black of the throat and pre-neck is replaced by white, as I had an opportunity of observing in a living bird, brought from St. Kilda in 1822." Again, then, there is no resisting the impression that on this point, also, nothing has been alleged, and no fact has been stated, which necessitates the acknowledgment of a very high antiquity for these heaps, and for the men who raised them.

Before referring to the lake, or pile dwellings—houses raised on stakes driven into the mud deposits at the bottom of lakes, after the manner followed by certain tribes in New Guinea at the present day—it must be asked, Is the archæological generalisation warranted which embraces all pre-historic time under the three divisions, the Stone Period, the Bronze Period, and the Iron Period? I think not. For working purposes it is con-

venient and useful, just as is the classification of the great geologic ages, which gives us Palæozoic, Mesozoic, and Cænozoic. But the facts do not warrant us in separating the one period from the other, so that they shall in no case either interlace or overlap. As there are tribes who even still use only weapons of stone for purposes for which other tribes use instruments of iron, so may it have been—indeed, so it was—in primeval times. In the present case, no doubt, the distance between the two is geographically great; but in bygone ages they may have lived so near as often to have rallied to one place and under one leader. In the army of Xerxes we know that this was so. Since the time when Professor Worsae first proposed this scheme for the acceptance of northern and British antiquaries, it has undergone many modifications. Both bronze and iron have been found much lower down, and under far different associations, than had been expected when the division was made.

The remains of lake dwellings have been discovered in Switzerland, in Ireland, and in Scotland. In Switzerland the most important occur. Connected with them have been found tools, such as hammers, axes, celts, fragments of rude pottery, articles of bronze, fishing-gear, and the like; remains of wheat, barley, apples, pears, plums, etc.; and traces of fifty-four species of animals, all of which, with the exception of the urus, are still living. The very farthest point back to which a survey of these would compel us to go, would be to the time when the urus became extinct, a date, no doubt, long subsequent to the time of Cæsar.

With these notices we may now turn to the geologic aspects of this great question. In doing so, it is frankly

acknowledged, in the outset, that this branch of the subject is surrounded with many difficulties. This arises from the extent of ground to be reviewed, and the great number and variety of, so-called, facts adduced to prove a far more remote date for the appearance of man than has hitherto been granted, and the want of anything like general unanimity among working geologists, as regards the interpretation of quaternary superficial deposits. But while these difficulties beset the question, our way is now comparatively clear. We have got rid of many distracting topics associated with the physico-theological aspects of Genesis i., and also with the zoological bearings of the subject, and may now turn to these leading branches:—(1) The question of the contemporaneity of man with certain animals now long extinct; (2) the remains found in peat mosses; (3) in silt; and (4) in superficial gravels.

Cuvier's "Theory of the Earth" has already been referred to. When reviewing what he calls "extraneous fossils in loose strata," he says, "Every circumstance, therefore, contributes to establish this position, that the human race did not exist in the countries in which the fossil bones of animals have been discovered at the epoch when these bones were covered up, as there cannot be a single reason assigned why men should have entirely escaped from such general catastrophes; or, if they also had been destroyed and covered over at the same time, why their remains should not be now found along with those of the other animals. I do not presume, however, to conclude that man did not exist at all before these epochs. He may have then inhabited some narrow regions whence he went forth to re-people the earth after the cessation of

these terrible revolutions and overwhelmings. Perhaps even the places which he then inhabited may have been sunk into the abyss, and the bones of that destroyed race may yet remain buried under the bottom of some actual seas; all except a small number of individuals who were destined to continue the species." The words are weighty and suggestive, but they have recently been set in lights which their author could never have anticipated. Some, even of those who had enjoyed the high privilege of listening to the words of the great man who uttered them, have recently quoted them as if they implied, that Cuvier did not believe it possible there could have been contemporaneity between man and these extinct animals. Others, again, have read them as if Cuvier intended to affirm, that man and these animals had lived together till the time of the Flood. When that awful judgment fell on the earth they hold they were swept away along with the rebel human race. It is impossible to see how such constructions can be put on these words. All that the father of modern comparative anatomy wishes here to be understood is, that when the words were written no well-authenticated human remains had been discovered along with those of the extinct animals. He virtually says, If the bones of pachyderms or of carnivora have been preserved, why have we not the bones of men, especially seeing that they have constituent peculiarities as likely to secure their preservation as the bones of the lower animals had? He leaves the question here, and refuses to retard the progress of discovery by any opinion adverse to such progress. Man and these animals may have been alive at the same time; but we have no proof that such was the case. This is all. He spoke from

the point of view of the knowledge of his own day. Since that period, science has been steadily advancing. More attention has been given to the stratigraphical relations and palæontological contents of superficial strata, and many discoveries have thus been made which could not have been anticipated when Cuvier wrote the sentences now quoted. Traces of man have been abundantly met with in the same deposits as those in which many remains of extinct animals have been found. Thus the question has been raised, Does the fact of *contiguity* warrant the assumption of *contemporaneity*? The question is surrounded with difficulties, connected chiefly with theories as to the time of the deposition of the quaternary beds in which the remains occur.

Without looking at all the forms of extinct animals, or of animals which inhabit other zones than those in which their remains are now to be met with, let us limit our remarks to such as have been most frequently referred to in discussions on the antiquity of man. These are contained in the genera *Bos* (ox), *Cervus* (deer), *Elephas* (elephant), *Felis* (cat), *Hippopotamus*, *Hyæna*, *Rhinoceros*, *Megaceros* (Irish deer), and *Ursus* (bear). Representatives of all these have been found either in superficial or in cave-deposits.

Two well distinguished species of oxen, the marsh cow (*Bos longifrons*) and the wild bull (*Bos primigenius*), both of which have been long extinct, can be traced into the historical epoch. The former has left such traces of its presence as do not permit us to doubt, that it continued in this country long after the Roman invasion. The latter, again, is the urus of Cæsar. So that, however many disputes may be raised as to their specific characteristics, and the precise time of their

extinction, they may be dismissed with one remark: If in the stone period even traces of their presence have been found, we are not entitled to claim a very high antiquity for that period, so far as they are concerned.

In the now noted Brixham cave (Devonshire), a perfect antler of the reindeer (*Cervus tarandus*) was discovered sticking in a layer of stalagmite; and in the second deposit, or bone-earth, bones of the same animal were found associated with knives of flint. In the Gower caves, again (Glamorganshire), not fewer than 1,000 antlers have been gathered. "These," says Sir Charles Lyell, "were mostly shed horns, and of young animals, and had been washed into the rent with other bones, and with angular fragments of limestone, and all enveloped in the same ochreous mud. Among other bones were those of the cave-bear, wolf, fox, ox, stag, and field-mouse."

We think it will be difficult to escape the conclusion that, here again, we have an animal, which no longer inhabits middle and southern Europe, contemporaneous with man. The reader of Sir Charles Lyell will notice that he is inclined to assign a great antiquity to the flint knives of the Brixham cave, from the mode in which they are associated with the remains of the cave-bear. But in the Gower caves we have the bones of the cave-bear mingling with those of the fox, ox, stag, and field-mouse; a fact which brings the existence of that animal much nearer to us than many seem to think. It gives it a place among present fauna. But great climatal changes, it is said, must have taken place since then, and the period of the change must have been long protracted. Here, however, we have evidence of such animals as the fox and field-mouse having lived through

these changes, and continued to our day. There is another fact which seems to tell in the same direction. At Savigné, in the department of Vienne, France, remains of the reindeer are associated with stone instruments of a superior make, and even a stag's horn, on which figures of two mammals are engraved in outline. Pre-Raphaelite figures, of course! In the Aurignac cave (Haute Garonne), remains of the reindeer, and of the *Megaceros*, or great Irish deer, are found with those of the wild cat, the badger, the wolf, the fox, the horse, the ass, and the stag, all of which still survive; while associated with these are bones of the hyæna, the cave-lion, the mammoth, and the Siberian rhinoceros. If we should regard only the group whose representatives are still around us, no great antiquity would be assigned to the *Megaceros*; if the other and extinct group, we might think ourselves warranted in throwing the period of its extinction very far back. The truth, however, lies between these alternatives. The great Irish deer may have been contemporary with the latter, and have lived so much longer as to have come near to our own time. The condition in which its bones are met with warrant the supposition. But the association of these forms is highly suggestive. Everything points to their contemporaneity with man.

Much has been made of the presence of bones of the *Hippopotamus major* in Britain, and in the lower gravel of the Somme valley; in places, too, in which there are no traces of such large pools of water as these animals delight in. But the migratory habits of these animals are well known; and even Sir Charles Lyell is willing to allow this. "Dr. Smith," he says, "relates, that in an expedition which he made north of Port Natal, he found

hippopotami swarming in all the rivers about the tropic of Capricorn. Here they were often seen to have left their footprints in the sands entering or coming out of the salt water; and on one occasion Smith's party tried in vain to intercept a female with her young as she was making her way to the sea. Another female, which they had wounded in her precipitate retreat to the sea, was afterwards shot in that element. The geologist, therefore, may freely speculate on the time when herds of hippopotami issued from North African rivers, such as the Nile, and swam northwards in summer along the coasts of the Mediterranean, or even occasionally visited islands near the shore. Here and there they may have landed to graze or browse, tarrying awhile, and afterwards continuing their course northwards. Others may have swam in a few summer days from rivers in the south of Spain or France to the Somme, Thames, or Severn, making timely retreat to the south before the snow and ice set in." Again, he says, "They may have resembled in this respect the musk-buffalo, herds of which pass for hundreds of miles over the ice to the rich pastures of Melville Island—70·10 N. lat. 110 W. long.—and then return again to southern latitudes before the ice breaks up."

With such habits as these, characterising well-known living forms, it is not easy to see why the same facts are not allowed to shed light on the presence of many animals in pre-historic times, in quarters very far removed from those which, from climatal considerations, we assign to them as their proper habitats. The likelihood here, also, is that the hippopotami of the Somme, Thames, and Severn were contemporaneous with man.

But the form which more than others has had attention drawn to it, is that of the mammoth (*Elephas primigenius*). In 1799 the body of a mammoth was discovered in "the frozen soil of a cliff at the mouth of the river Lena, in Siberia. The skin was clothed with a reddish wool, and with long black hairs. It is now preserved at St. Petersburg, together with the skeleton. It measures from the fore-part of the skull to the end of the mutilated tail, sixteen feet four inches; the height to the top of the dorsal spines, is nine feet four inches. The length of the tusks along the curve is nine feet six inches. Parts of the skin of the head, the eye-ball, and of the strong ligament of the nape, which helped to sustain the heavy head and teeth, together with the hoof, remain attached to the skeleton." Before it attracted the attention of a chief of a tribe inhabiting that region, the wolves and wild dogs had preyed on this huge carcass. The flesh of this animal is described as being at the time "raw and bloody." A molar tooth of the mammoth was found some time ago near Torquay, and is placed in the museum there. In 1820, when the Union Canal between Edinburgh and Glasgow was being formed, the workmen in digging the course for the canal came upon a mammoth's tusk. At the time the late Mr. Bald described it, as having been found in the boulder-clay, but grave doubts were afterwards thrown on this by competent observers. "A fissure in the clay," says the late Professor Fleming, "may have received the tooth, and the clay washed in along with it, and hence the state of preservation may be satisfactorily accounted for." This tusk is now deposited in the museum of the New College, Edinburgh. Part of

another tooth, preserved in the Edinburgh University Museum, was found in surface clay overlying beds of freestone, in a quarry near Kilmaurs, Ayrshire, in 1817.

We have thus evidence that the range of the mammoth was, in pre-historic times, very wide. Had we only possessed the tusks and the bony skeleton, it might have been affirmed that this huge mammal had perished long before man appeared on the scene. But what are we to make of the fact that the muscular tissue of the Lena specimen was actually "*raw and bloody*"? It is not conceivable, that any conditions could have met of a kind fitted to preserve for thousands of years a carcass in such a fresh state. It is quite conceivable, however, that the rude instruments and weapons of the native Siberian, or of wandering tribes, might have been found side by side with, or even sticking fast in, the bones or tissue of the animal. But should we have been thereby warranted, first, to throw back the age of the weapons a thousand or two thousand years, and then to predicate contemporaneity between the mammoth and the man who used the weapons? Yet this is virtually what, in many cases, we are asked to do. The truth is, that as animal forms, in becoming gradually extinct, throw individual members forward into periods long posterior to the time of their chief development and prevalence, so the rude weapons which, at some remote period, were the only ones used by certain tribes, linger among the people in districts remote from the centres of influence and thought. At the present time, for example, I have met with the hand-mill, or quern, in use in some of the Western Islands, while Lowland antiquaries are storing them

away in museums as interesting reliques of a bygone age and a rude people.

The conclusion, then, to which we are compelled to come in regard to these extinct animals is, that man was contemporary with them. As he wandered from the original seat of the human race, or, as venturing on the deep, was driven on shores inhabited by forms such as these, he had to do battle with them. Already decreasing, the process was hastened by his destructive propensities, and ultimately they came to be reckoned among the forms which had been. This, indeed, is the process in all quarters of the world. Everywhere the words used by Sir Charles Lyell, in his "Second Visit to the United States," with reference to the extinct quadrupeds of that country, are true: "They were exterminated by the arrows of the Indian hunter."

While on this topic, reference may be made to the Newburg mastodon. The history of this specimen seems to warrant the belief, that even it may have co-existed with man. Some of the finest specimens ever exhumed of the bones of this animal were dug out of a peat moss in Newburg, N.Y., in 1845, and are now exhibited in Dr. Warren's collection, Boston. The bones were remarkably fresh when found, and even the masticated twigs of which his last meal was composed were preserved in the stomach. The animal had become mired in a bog, doubtless when in quest of his favourite food. His immense weight caused him to sink so deep in the marl and peat that extrication was impossible. The bones rested chiefly in a marl bed, like those which are forming every day. Above this was a bed of peat about three feet thick. We have no

means of knowing the rate of growth of peat in this country; but by assuming a rate rejected by Lyell as too small for the valley of the Somme, a brief calculation shows that three or four thousand years would be a sufficient time for its growth; and even this would seem to be an exaggerated estimate. It would not be strange, indeed, if the gigantic animal had become mired some time after the peat had begun to form, and had sunk entirely through the higher stratum.

Such are the leading facts of this aspect of the question. If a review of them forces us to acknowledge the coexistence of man with these animals, it must ever be borne in mind: First, That the extinction of specific forms says nothing about their age. Examples of about forty species of birds and mammals might be named which have all become extinct within the historic period—some of them, indeed, within the last thirty years. Second, That there is proof that some of the oldest are younger than the period of the boulder-clay. Third, That no data have yet been discovered which warrant any conclusions as to the age, by years, of the deposits in which some of the forms, held to be oldest, have been found. In reference to the Gower cave specimen, for example, the late Dr. Falconer, one of the most accurate observers of his day, says:—

“1. That the Gower caves have probably been filled up with their mammalian remains since the deposition of the boulder-clay.

“2. That there are no mammalian remains found elsewhere in the ossiferous caves in England and Wales referable to a fauna of a more ancient geological date.

“3. That *Elephas (Toxodon) meridionalis* and *Rhino-*

ceros Etruscus, which occur in, and are characteristic of, the 'submarine forest bed' that immediately underlies the boulder-clay on the Norfolk coast, have nowhere been met with in the British caverns.

"4. That *Elephas antiquus* with *Rhinoceros hemitæchus*, and *E. primigenius* with *Rh. tichorhinus*, though respectively characterising the earlier and later portions of one period, were probably contemporary animals; and that they certainly were companions of the cave-bears, cave-lions, cave-hyænas, etc., and of some at least of the existing mammalia."

It will be seen, by referring to page 195, that the theory stated there implies, that the forms held to have coexisted with present mammalia did not belong to true geological time.

CHAPTER XII.

ANTIQUITY OF MAN CONTINUED.

Superficial deposits—Peat—Stone, bronze, and iron periods of the antiquary—Danish peat zones—American peat—Scottish peat—False conclusions—Dr. Dowler's calculations—Cypress swamps of the Mississippi—Peat of the Outer Hebrides—Mud deposits—Mr. Horner on Nile mud—Plains of Bengal—Dr. Buist on the formation of Lower Bengal—The loess—Cave-men—Discoveries of Dr. Schmerling—Liège caverns—Engis skull—Valley of the Neanderthal—The Neanderthal skull—Professors Huxley and King's views of this skull—M. Lartet on the cave-men of Aurignac—Gravels of the Somme valley—Mr. Prestwich's views—Excavation of valleys—Influence of ice—Oscillations of level—Quotation from Sir Roderick Murchison—Morlot on the study of high antiquity—True science corroborates the Biblical account of the recent appearance of man.

WE come now to the phenomena of superficial deposits—the geological aspects of the question of the antiquity of man. In dealing with these, it will give definiteness to the argument if we classify, as has been suggested, the deposits as peat, mud, and gravels, taking the bone-caves with the last.

I. PEAT. The state of the question is so clearly and briefly stated by Sir Charles Lyell, that we may best bring it out by quoting his words. He says, "The deposits of peat in Denmark, varying in depth from ten to thirty feet, have been formed in hollows or depressions in the northern drift, or boulder formation. The lowest stratum, two or three feet thick, consists of swamp peat, composed chiefly of moss or sphagnum, above

which lies another growth of peat, not made up exclusively of aquatic or swamp plants. Around the borders of the bogs, and at various depths in them, lie trunks of trees, especially of the Scotch fir (*Pinus sylvestris*), often three feet in diameter, which must have grown on the margin of the peat mosses, and have frequently fallen into them. This tree is not now, nor has ever been in historical times, a native of the Danish islands, and when introduced there has not thriven; yet it was evidently indigenous in the human period, for Steenstrup has taken out with his own hands a flint instrument from below a buried trunk of one of these pines. It appears clear that the same Scotch fir was afterwards supplanted by the sessile variety of the common oak, of which many prostrate trunks occur in the peat at higher levels than the pines, and still higher the pedunculated variety of the same oak (*Quercus robur*, L.) occurs with the older birch (*Betula verrucosa*, Ehr.) and hazel. The oak has now in its turn been almost superseded in Denmark by the common beech. Other trees, such as the white birch (*Betula alba*), characterise the lower part of the bogs, and disappear from the higher; while others, again, like the aspen (*Populus tremula*), occur at all levels, and still flourish in Denmark. All the land and fresh water shells, and all the mammalia as well as plants whose remains occur buried in the Danish peat, are of recent species."

We have here, it is alleged, three ages distinctly marked, and when the articles found in the refuse-heaps and in other superficial deposits are taken into account, it is said that we are warranted in associating the three ages of the peat with three well marked pre-historic periods. First, a stone

period, in which the inhabitants were brachycephalous, or characterised by short heads and small bodies, like the modern Laplanders, and who used implements manufactured chiefly from stone, never from metals. During this period the Scotch fir (*Pinus sylvestris*) predominated in the forests. Second, a bronze period, in which the inhabitants were larger than in the stone age, and used many implements of bronze (an alloy of copper and tin) in addition to those made of stone. The forests in this period were chiefly composed of the oak (*Quercus robur*). Third, an iron period, in which implements manufactured from iron superseded those of stone and bronze, and the forests were largely occupied by the beech-tree (*Fagus sylvatica*).

A survey of these peat deposits necessitates, it is held, the acknowledgment of a very high antiquity for the men who have left traces of their presence in them. Since the conclusions of the Danish antiquaries were published, much more attention has been given to peat deposits, both in this country and in America, than had hitherto been the case. While much still remains to be done, we are, notwithstanding, in circumstances to show that the great age of the peat is not so clear as, at a comparatively recent date, it was held to be. Let us glance, then, at the strong points in the quotation from Sir Charles Lyell's work.

First. Three zones, alleged to indicate three ages, are named from the characteristic trees embedded in them—the fir, the oak, and the beech zones. Nothing like this has been found in Britain, but fortunately America supplies illustrations of a kind suggestive of conclusions widely different from those come to by the Danish observers, and accepted by the British

advocates for the high antiquity of man. The beech, they say, is known to have flourished at the time of the Roman ascendancy in Europe, and is likely to have done so four or five hundred years before. It still exists. The beech zone then may be taken as representing two thousand years. Giving the same to the other two, we have six thousand years. But as Professor Steenstrup found a flint knife under one of the trees of the oldest zone, there must have been stone implement makers alive in Denmark at the time usually associated with the creation of Adam.

In a communication recently received from Prof. C. Hitchcock relative to the American forests, he says: "We cannot avoid allusion to facts respecting the growth of peat and of forest trees, which do not seem to have entered sufficiently into the basis of the Danish calculations. The growth of peat is extremely variable, even in contiguous swamps. It accumulates much more rapidly in the primitive forest than after clearings have been effected; chiefly, perhaps, because in a wooded country rain is more common, as any one who has travelled in a wild northern region cannot have failed to notice. When aided by obstructions, such as a windfall or a beaver-dam, its growth progresses rapidly; but when drainage has been established, and the trees removed, it forms very slowly. The basis of the calculation is founded upon the rate of growth when much of the country has been cleared, and must manifestly be much too small to indicate the amount of peat deposited in the bronze and stone ages. In relation to the rapidity of the succession of trees in forests, we can judge better in America than in Europe, because the primitive forest still flourishes

with us in many localities, and we can also examine several centuries of the subsequent growth. The original Danish forest of Scotch fir may have been destroyed by fire in a single season, as is often the case in North America. The great blackened trunks would have remained as monuments of the calamity for half a century, when they would have been replaced essentially by the 'second growth,' which, with us, consists of birch, poplar, and similar trees. In two or three centuries, the new forest would have become thoroughly established, but for the most part composed of different trees from our second growth. In Denmark, the second forest seems to have been of oak, which must have flourished for a long period, and, if not destroyed by human agency, could be replaced only by another variety of tree, better adapted to the soil and climate. The draft of the substances from the soil fitted for the sustenance of one particular kind of tree would, in the course of centuries, leave some other inorganic element predominant, better suited for the growth of some other tree. In Denmark, oaks were apparently succeeded by beeches, both of which extend themselves very slowly. But it does not agree with our observations to expect that the whole forest would have been made up exclusively of either firs, oaks, or beeches. Our primitive forests commonly contain a 'mixed growth;' it is generally very limited valleys or hill-tops that are covered by only one kind of tree. Pine, spruce, juniper, and maple are intermixed in equal proportions in some regions, while oak, hickory, and chestnut predominate elsewhere. Observation would therefore indicate the probability of a mixed growth in the stone and the bronze, as well as in the iron age.

For this reason we must leave a margin in our calculations of time from the succession of forests; certain districts having the oaks predominating longer than others, may have been those taken for the calculation. Estimating from these new stand-points, we may say that the minimum time required to produce the changes observed in the Danish forests may be two thousand years."

But more; this rash and hasty generalisation as to well-marked periods, will at once be seen to be most fallacious, when we take into account the fact that the trees are stated to have grown on the edges of the moss and to have fallen into it. Slips, which year after year occur in this country on the edges of peat swamps might bury Scotch firs growing on their borders, situations in which they flourish luxuriantly, but where neither the oak nor the beech grows well. Thus laid down, the swamp might reach the oaks farther removed, and take them in too. I am acquainted with one swamp of this kind (described at a meeting of the Royal Society at Edinburgh, March, 1862), in which birches (*Betula alba*) which had, at a comparatively recent period, sent their roots into the cracks in the boulder-clay, had been covered by peat from five to seven feet deep. In 1861 a slip on a large scale occurred, and great masses of peat, carrying the roots and stems of birch in them, were pushed over a Scotch fir plantation growing on the edge. Suppose a labourer had dropped at the root of the Scotch firs one of those wooden spoons still used in the district! It would of course have been covered by five feet of peat, in the middle layers of which the silver birch roots and branches are found resting. And now among the grass already beginning to grow, a horn spoon is dropped and falls into a cre-

vice which takes it within two feet of the wooden one, while on the surface the iron spoon, now the staple article of this kind [in the district, is picked up by the antiquary who has just made a section of the peat. Here, surely, would be an opportunity for generalisation! An age of Scotch firs synchronising with an age of wooden spoons, an age of white birches answering to the age of horn spoons, and as branches of the elms to be met with not far off have found their way to the moss, an age of elms synchronising with that of iron spoons! But the elm still flourishes, says the antiquary of sixty years hence; and in rude districts, the iron spoon is used, while both the wooden and the horn ones are only to be met with in museums. Therefore,—but we may draw any conclusion which the phenomena clearly warrant!

It will thus be seen that very little weight is to be attached to Professor Steenstrup's flint weapon. If this kind of reasoning is to be allowed in a great question like the present, there would be no limit to the absurdity of the conclusions. Let us take one illustration, referred to by Sir Charles Lyell, who, however, is sceptical as to its value; why he should be so, when he is so ready to accept others as improbable, is not very clear. He says, "In one part of the Modern Delta (of the Mississippi) near New Orleans, a large excavation has been made for gas-works, where a succession of beds, almost wholly made up of vegetable matter, has been passed through, such as we now see forming in the cypress swamps of the neighbourhood, where the deciduous cypress (*Taxodium distichum*), with its strong and spreading roots, plays a conspicuous part. In this excavation, at the depth of sixteen feet from

the surface, beneath four buried forests superimposed one upon the other, the workmen are stated by Dr. Dowler to have found some charcoal and a human skeleton, the cranium of which is said to belong to the aboriginal type of the Red Indian race. As the discovery in question had not been made when I saw the excavation in progress at the gas-works in 1846, I cannot form an opinion as to the value of the chronological calculations which have led Dr. Dowler to ascribe to this skeleton an antiquity of 50,000 years." The leading American geologists long ago pointed out the utter uncertainty of this estimate. No weight is now attached to Dr. Dowler's discovery. The precise number of years assumed was 57,600 !

Second. Does what we now know of the rate at which peat grows forbid any conclusions, as to the necessarily great age of articles which may be found at the bottom of peat swamps? The whole of this aspect of the subject turns on the answer to this question. We have given much careful attention to peat deposits, and examined many both in the north and south of Scotland. Other observers have gathered many facts, and we may now with some certainty venture to calculate the probable rate of growth. In 1862, Captain F. N. L. Thomas read a paper before the Royal Physical Society on the "Geologic Age of the Pagan Monuments of the Outer Hebrides," in which many valuable facts are stated as to the growth of peat. I have recently examined with much care the phenomena alluded to in this paper, and can confidently speak to the correctness of the observations. Referring to some of the so-called Druidical circles, he says, "One of these circles, the far-famed stones of Callanish, occupies the flat of a

ridge of hilly ground, while two others are near together on a wet and boggy moor at the distance of a mile to the eastward of the first. If the circles situated on the moor had been visited two or three years ago, nothing but a few grey blocks, even with, or protruding two or three feet above, the bog, would have been seen, and many of the stones of the large circles of Callanish were completely grown over and buried in peat." These three circles were cleared, and it was found that the peat had accumulated to the height of between five and six feet. After a careful examination, Captain Thomas concluded that the stones had been erected before the peat began to grow. The stones stand in the boulder-clay, and the peat was found to have risen uniformly all round them; showing that holes had not been dug in the peat to receive them. Thus an approximation to a correct estimate of the age of these monuments would be made, if the annual increase of the peat were known. In 1863, Captain Thomas continued his observations, and in February (1865) he furnished me with the following note:—"The lamination of the weathered peat is very imperfect (the fracture, in mineralogical terms, is *imperfect slatey*), but an average of many trials gave fifteen lamina to the inch. If one inch represents a growth of peat of fifteen years, six feet would have grown in 1,080 (say 1,000) years, and eight feet in 1,440. It is probable that these numbers are approximate to truth. When engaged in making these observations, I came upon the ashes of a fire that had been made of sticks, on the naked rock *below all the peat*. The peat bank above the ashes was quite the same as the peat around and about. I believe the fact to be very important." One practical gentleman assured him that Lewes peat

grew an inch a year. Another estimate is nine inches in a century.

"A common tradition of the Lewis," he says, "is that the ground was once entirely covered with forest trees, and that the wood was burned down by the Northmen to deprive the aborigines of the shelter it afforded." "I may mention that, to my surprise, one of the Lewis bards has a tradition that at one time there was no peat in the Lewis; and it is also to be noted that almost always, on excavating any of the Pictish dwellings, pieces of burnt stick (charcoal) are found at the fire-hearth." Now, it is impossible to look carefully at these facts, and resist the impression that the peat of the Lewis is comparatively recent. There seems to have been a period when trees were somewhat common—a period antecedent to that of the peat era. This was the time when the builders of the so-called Druidic circles peopled the island; and, if we take generally Captain Thomas's data, the close of that period, as indicated by the growth of the peat, answers remarkably to what we know to have been its close from other sources of history. Before leaving this, another point may be mentioned, which, as it seems to us, Captain Thomas has made good, namely, that there has been of late in the peat-growing period, a subsidence of the land to the extent of nearly nine feet. This conclusion is come to after carefully examining peat banks which are now submerged by the sea at high-water.

We may now pass from this branch of the subject, cherishing a well-founded conviction, that conclusions as to the slow growth of peat, which have been so much made of and so often appealed to, are not based on trustworthy data.

Third. In turning to the phenomena of mud deposits, even more care is required in examining alleged facts. The late Mr. Leonard Horner first gave special prominence to this aspect of the question. In two Memoirs, communicated to the Royal Society in 1855 and 1858, the result of ninety-five vertical borings through the alluvium formed in the Nile valley are recorded. In the excavations near the colossus of Rameses II. at Memphis, there were nine feet four inches of Nile sediment between eight inches below the present surface of the ground and the lowest part of the platform on which the statue had stood. Supposing the platform to have been laid in the middle of the reign of that monarch, viz., 1361 B.C., such date, added to A.D. 1754, gives 3,215 years during which the above sediment was accumulated; or a mean rate of increase of three and a half inches in a century. Below the platform there were thirty-two feet of the total depth penetrated; but the lowest two feet consisted of sand, below which it is possible there may be no true Nile sediment in this locality, thus leaving thirty feet of the latter. If that amount has been deposited at the same rate of three and a half inches in a century, it gives for the lowest part deposited an age of 10,285 years before the middle of the reign of Rameses II., and 13,500 years before A.D. 1854. The Nile sediment at the lowest depth reached is very similar in composition to that of the present day. In the lowest part of the boring of the sediment at the colossal statue in Memphis, at a depth of thirty-nine feet from the surface of the ground, the instrument is reported to have brought up a piece of pottery. This therefore, Mr. Horner infers to be a record of the existence of man 13,371 years before A.D. 1854.

Mr. Horner's conclusions are referred to by Sir Charles Lyell, but he does not now attach the value to them which he once did. Their weak points are indicated, and, as far as the districts go, on the examination of which Mr. Horner inferred that he had a record of the existence of man for 13,000 years, the conclusions are given up by Egyptologists as not satisfactory. This has resulted mainly from the keen way in which Mr. Horner's conclusions were canvassed. Here again we have a full proof that in the present state of science, when so many workers are in the field, and such a ready homage is given to facts, by whomsoever stated, there is little ground for concern lest the truth suffer, if only her disciples will fit themselves for her defence. And what those who are working have a right to claim is, that on-lookers should not, "in sheer indolence and unconcern, diverge from the right path, because illustrious men may have led the way."

But while the alleged facts of Mr. Horner have little weight assigned to them, the very principles which he applied, with the view of determining the thickness of the sedimentary deposits of the Nile valley as a test of the lapse of time, are held by Sir Charles Lyell and others as sound when applied to other deposits, or indeed to the Nile mud generally;—exception being taken only to inferences drawn as to the thickness of the sediment near the temples or public buildings within reach of the waters at their overflow. "Herodotus tells us," says Sir Charles, "that in his time those spots from which the Nile had for centuries been shut out, appeared sunk, and could be looked down into from the surrounding grounds, which had been raised by the gradual accumulation over them of sediment annually thrown down.

If the waters at length should break into such depressions, they must at first carry with them into the enclosure much sand washed from the steep surrounding banks, so that a greater quantity would be deposited in a few years than perhaps in as many centuries on the great plain outside the depressed area, where no such disturbing causes intervened."

Now this is the point of view at which many observers have arrived, in regard to the general question. They hold that everywhere disturbing causes, irregular and abnormal, have periodically acted over those large areas for whose sedimentary deposits an immense antiquity is demanded and assumed, and have left behind them appearances analogous to those alluded to by Sir Charles Lyell. This, indeed, is now the topic of greatest interest connected with these mud deposits. Let us suppose that Dr. Dowler had convinced men of science generally, as he did convince some, that the phenomena of the superficial deposit at New Orleans were correctly read, it would have been impossible to resist the soundness of his reasoning, and there would have been no way of meeting this, except by questioning his mode of accounting for these phenomena. Or suppose, that in the mud of the Nile, in quarters open to no such objections as those examined by Mr. Horner, bits of pottery, or knives of nephrite, or any traces of human art had been found, or should yet be found, which is not at all unlikely, how could we meet the claim for a date which would carry man back 20,000 or 30,000 years? Only in one way—we have no adequate proof that we are right either as to the mode or the rate of deposit? This is now the point at issue. For a good while it was somewhat complacently taken

for granted, that there could be no doubt here. But let us be thankful, for the sake of science not less than of Christian thought, that a conviction of the untrustworthiness of the supposed evidence is now beginning to influence many who once held a confident attitude on the other side.

Passing from this, let us indicate one or two points of much importance here. "The vast plains of Bengal," says Sir Charles Lyell, "are overspread with Himalayan mud, which, as we ascend the Ganges, extends inland for 1,200 miles; continuing very homogeneous on the whole, though becoming more sandy as it nears the hills. . . . Borings have been made at Calcutta, beginning not many feet above the sea-level, to the depth of 300 and 400 feet; and wherever organic remains were found in the strata pierced through, they were of a fluvial or terrestrial character, implying that during a long and gradual subsidence of the country, the sediment thrown down by the Ganges and Burrampooter had accumulated at a sufficient rate to prevent the sea from invading that region." Now let us set over against this statement, so suggestive of an antiquity for the Gangetic mud which few would venture to name, the following remarks of the late Dr. Buist, an able geologist, an accomplished naturalist, and one who early distinguished himself in this country, before he went to India, in connexion with the phenomena of superficial deposits. "In the very admirable papers," says Dr. Buist, "of Colonel Baird Smith and Dr. McClelland, published in the 'Calcutta Journal of Natural History,' in 1840, on the delta of the Ganges, a deposit which has been far more carefully and philosophically ex-

amined than that of the Nile, the assumption, which now seems almost self-evident, is started with, that Lower Bengal, when the present silting up began, was an arm of the sea, and that the mass of diluvium, measured to the depth of 430 feet, or ten times that to which the hill has been examined, was deposited through a succession of depressions and upheavals in comparatively tranquil waters. The time consumed in this operation is estimated, on data as exact as the case permits, at above 3,500 years. The bones and fragments of wood found at this depth had not lost their structure or even their sap; their solid matter was scarcely changed, and there is little reason to doubt but they were at least as old as the bit of pottery to which an antiquity of 13,000 years is assigned. The mangrove wood found ten feet beneath the upper surface of our Bombay raised beaches is fresh enough to be turned on the lathe."

When referring to other phenomena, Dr. Buist incidentally answers the objection drawn from the alleged absence of marine shells from the deposit, though it is illogical for the advocates of the antiquity of man to make so much of negative evidence. He says—"Herodotus, who flourished 440 years before Christ, states that the learned men of Egypt told him, that in the time of Menes, who founded the Egyptian monarchy 2,200 years before Christ, the land of Egypt, from the Theban provinces northward, was a marsh, and that from the lake Mæros, about a hundred miles from the sea-shore at Alexandria northward, was permanently under water. The Greek historian concludes from this that the Delta was a gift from the river, and the soundness of the

conclusion seems unquestionable. No weight need be attached to the note of the learned translator, Principal Arnold, that the theory is disposed of by the absence of marine remains to the depth of forty feet, seeing with what rapidity these, under certain circumstances, are destroyed, and how limited and imperfect is our information on the subject. The whole alluvium of Bombay is marine, yet ten thousand borings might be made in our brown clay without discovering a shell; they are present only when preserved in nodules of kunker (calcareous concretions). The skeleton of a whale nearly perfect was, some thirty years since, dug out of the clay near Stirling in the valley of the Forth; the bones of a seal were in 1852 found near Falkland in Strath Eden—not a sea shell having ever been detected within twenty miles of them. On the other hand, a large bed of cockles is found near Perth reposing ten feet under the clay of the Carse of Gowrie above the roots of a land forest—nothing of the like kind being discernible in the vast expanse of cotemporaneous formations around.”

A brief reference to the *loess* of the Rhine will conclude our review of this branch of the subject. The *loess* is a very old alluvial deposit, reaching from the mouth into the valley of the Rhine. It is a fine loam of a yellowish-grey colour, consisting chiefly of argillaceous matter. It varies from ten to thirty feet in thickness, and “near Brussels caps some of the hills at an elevation of three hundred feet above the sea level.” In several places it is met with at an elevation of 1,500 feet. In it the bones of the elephant, rhinoceros, deer, and ox have been found. At Maestricht, on the banks of the Meuse, a tributary of the Rhine, a human lower-jaw with teeth

was found, in 1820, at a depth of sixty feet, and six yards distant horizontally from an elephant's tusk. But the fact that the *loess* occurs at such heights, implies oscillations of level of a kind which forbid all attempts to determine definitely the age of the deposit, and especially to deduce the antiquity of the embedded bones.

Fourth. The only other topics which now claim our attention, are those of the so-called cave-men, and the gravel deposits. When Dr. Buckland published his work, *Reliquiæ Diluvianæ*, he gave currency to the opinion, which several men of science held, regarding the association or intermixture of human remains with those of the extinct animals. He believed that this had occurred, because men had used the cave-dens of the animals as places of sepulture. This view was very generally accepted without much inquiry or investigation by working naturalists. "After," says Sir Charles Lyell, "giving no small weight to the arguments of M. Desnoyers, and the writings of Dr. Buckland on this subject, and myself visiting several caves in Germany, I came to the opinion that the human bones mixed with those of extinct animals, in osseous breccias and cavern mud, in different parts of Europe, were probably not coeval." With most inquirers, however, he has left this ground. We have, however, already seen that to grant the contemporaneity of man and the extinct animals, does not shut us up to the admission, that man must necessarily have been far longer on the earth than the time assigned to him in the Biblical record. Indeed, one of the very ablest observers expresses an opinion upon this point which suggests a ground of rest to inquirers, and which, perhaps, possesses more value than many

others which have had a higher importance ascribed to them. Speaking of some features in the post-glacial beds of the Somme valley, Mr. Prestwich says (1863): "Although feeling that the period in question is one of very remote antiquity, I still adhere to the opinion I had before expressed, that the evidence does not carry man back in past times more than it brings forward the great extinct mammalia towards recent times."

In 1833 the late Dr. Schmerling, of Liége, Belgium, undertook the examination of the numerous ossiferous caverns which border the valleys of the Meuse and its tributaries. The caves occur in the mountain limestone. Most of the material in these caverns seems to have been washed into them, through the numerous fissures which occur in the rock. "Many of the caverns had never before been entered by scientific observers, and their floors were encrusted with unbroken stalagmite. At a very early stage of his investigations, Dr. Schmerling found the bones of man so rolled and scattered as to preclude all idea of their having been intentionally buried on the spot. He also remarked that they were of the same colour, and in the same condition, as to the amount of animal matter contained in them, as those of the accompanying animals, some of which, like the cave-bear, hyæna, elephant, and rhinoceros, were extinct; others, like the wild cat, beaver, wild boar, roe-deer, wolf, and hedgehog, still extant. The fossils were lighter than fresh bones, except such as had their pores filled with carbonate of lime, in which case they were much heavier. The human remains of most frequent occurrence were teeth detached from the jaw, and the carpal, metacarpal, tarsal, metatarsal, and phalangeal bones sepa-

rated from the rest of the skeleton. The corresponding bones of the cave-bear, the most abundant of the accompanying mammalia, were also found in the Liége caverns more commonly than any others, and in the same scattered condition. Occasionally some of the long bones of mammalia were observed to have been first broken across, and then reunited or cemented again by stalagmite, as they lay on the floor of the cavern." "In the Engis cavern, distant about eight miles to the south-west of Liége, on the left bank of the Meuse, the remains of at least three human individuals were disinterred. The skull of one of these, that of a young person, was embedded by the side of a mammoth tooth. It was entire, but so fragile that nearly all of it fell to pieces during its extraction. Another skull, that of an adult individual, and the only one preserved by Dr. Schmerling in a sufficient state of integrity to enable the anatomist to speculate on the race to which it belonged, was buried five feet deep in breccia, in which the tooth of a rhinoceros, several bones of a horse, and some of the reindeer, together with other ruminants, occurred."

The reader will not fail to notice, that Dr. Schmerling's discoveries, as thus described by Sir Charles Lyell, afford no clue to the age of the remains found in the Liége caves. The presence of so many fragments of skeletons of animals still extant, with those of forms long extinct, forbid any conclusions as to a very high antiquity. Manifestly they had been washed into the fissures, after long exposure to weathering influences. But some are evidently much more recent than others, for they are not worn down or rounded, but have many of their most delicate parts preserved

with their sharp outlines. The proposed explanation of this is more curious than satisfactory. "This was accounted for by supposing, that portions of carcasses were sometimes floated in during floods while still clothed with their flesh!" As regards the association of the mammoth's tooth with the skull of the young person, many suppositions may be made to explain it. It might have been washed into the cave, or, at a comparatively recent date, it might have been picked up, when separated from the trunk, and deposited there by human hands. At any rate its worthlessness as to the question of the contemporaneity of man with the extinct mammoth is apparent.

For a time great stress was laid on the discovery of the other skull mentioned—the Engis skull. Not a few still cling to the belief, that it must have belonged to one of a great family which, in very remote, primeval times, inhabited Europe, and which were very low in the scale of intelligence. The answer to this cannot be better put than has been done by Professor Huxley himself. "Taking," he says "the evidence as it stands, and turning first to the Engis skull, I confess I can find no character in the remains of that cranium which, if it were a recent skull, would give any trustworthy clue as to the race to which it might appertain. Its contours and measurements agree very well with those of some Australian skulls I have examined, and especially has it a tendency to that occipital flattening, to the great extent of which, in some Australian skulls, I have alluded. But all Australian skulls do not present this flattening; and the supraciliary ridge of the Engis skull is quite unlike that of the typical Australian. On the other hand, its measurements agree equally well

with those of some European skulls. And assuredly there is no mark of degradation about any part of its structure. It is, in fact, a fair average human skull, which might have belonged to a philosopher, or might have contained the thoughtless brain of a savage." Such an opinion, so expressed, should for ever shut the Engis skull out of court, as a zoological witness to man's alleged high antiquity.

In one of the fissures the bones of the cave-bear have been found associated with sand, mud, angular and rounded stones. The sand fills the cave to the top. The detritus washed in has in time become consolidated, and the whole may now be regarded as a compact breccia or conglomerate. As a good deal has been made of this fact, it may be useful to indicate the process by which it is brought about. Rain-water falling on decaying soil, evolves carbonic acid; when water charged with this gas meets the limestone, a portion of the stone is dissolved, and falls as carbonate of lime on the floor in the form of stalagmite, or is deposited on the walls and hung from the roof of the cave as stalactite. While this has been going on, occasional floods have deposited mud and sand in the caverns. Thus the occurrence of bands of mud between layers of stalagmite. No great stress is to be put on the fact, that some of these caverns are now higher than the level of the stream—in one cave nearly 200 feet—because the whole district is not far from the cones of the extinct volcanoes of the Eifel; and many parts of it testify to the action of disturbing forces at a comparatively recent date. The existence of these old craters at a distance of sixty miles, introduces elements of uncertainty into any attempts to define the age of the

caverns. The same considerations we shall find to carry with them lessons of caution, when we come to look at other closely-related phenomena.

“It will be desirable,” adds Sir Charles Lyell, “to say something of the geological position of another skull, or rather skeleton, which, on account of its peculiar conformation, has excited no small sensation in the last few years. I allude to the skull found, in 1857, in a cave situated in that part of the valley of the Düssel, near Düsseldorf, which is called Neanderthal. The spot is a deep and narrow ravine, about seventy English miles north-east of the region of the Liége caverns, and close to the village and railway station between Düsseldorf and Elberfeld. The cave occurs in the precipitous southern or left side of the winding ravine, about sixty feet above the stream, and a hundred feet below the top of the cliff.” The rock in which it occurs is also limestone, which is pierced with many fissures. Loam covered the uneven bottom of the cave, in some parts to the depth of five feet. It was in removing this that the skull and other parts of a skeleton were found. Only the skull was preserved.

The discussions which have gathered round the Neanderthal skull have assumed one of two forms. On the one hand, the thickness of the loam has been pointed to as an evidence of considerable antiquity. On the other hand, and chiefly, it has been strongly urged by some anatomists that we have here a link between man and the anthropoid apes.

It resembles the skull of an ape more than is usual, “not only in the prodigious development of the superciliary prominences and the forward extension of the orbits, but still more in the depressed form of the brain-

case, in the straightness of the squamosal suture, and in the complete retreat of the occiput forward and upward for the superior occipital ridges." But its cranial capacity, for which so much has been claimed by the development school, falls entirely within the limits even of the English skull, the greatest observed capacity of which is 114 cubic inches, and the smallest 55, while the minimum capacity of the Neanderthal specimen is estimated at 75 inches. Some Hindoo skulls have a capacity of 46 cubic inches, and the very highest capacity of the gorilla is 34.5 cubic inches. This skull is of an elongated oval form, about an inch longer than ordinary British skulls, and about the same width. "The forehead," says Professor W. King, who pleads very strongly for the ape-like character of the skull, "is uncommonly low and retreating, terminates in front by enormously projecting brow or superciliary ridges, which, besides being very thick, slightly rounded on their anterior aspect, and rather strongly arched above the eye-sockets, extend uninterruptedly across from one side to the other. The outer orbital processes, or horns of the brow-ridges, are also unduly developed, being thick and projecting. On the whole, there is a remarkable absence of those contours and proportions which prevail in the forehead of our species; and few can refuse to admit that the deficiency more closely approximates the Neanderthal fossil to the anthropoid apes than to *homo sapiens*." After having examined the differential features of the skull, Professor King adds, "Notwithstanding the strong simial tendencies displayed by its general features, most of the writers who have described this skull do not appear to think otherwise than that it belonged to an individual of our species.

There seems to be no doubt, whatever, on the part of the honorary secretary of the Anthropological Society, Mr. Carter Blake, that the Neanderthal fossil is specifically identical with man. He considers it to be the remains of some poor idiot or hermit, who died in the cave where the bones were found. His reasons, however, are obviously unsatisfactory." "In reply to the suggestion," observes Huxley, "that the skull is that of an idiot, it may be urged that the *onus probandi* lies with those who adopt the hypothesis. Idiocy is compatible with very various forms and capacities of the cranium, but I know of none which present the least resemblance to the Neanderthal skull." Blake admits that its frontal peculiarities give the cranium an "apparent ape-like character;" but if such peculiarities be the result of mal-development producing idiocy, one would be equally justified in believing that the form of the skull of the gorilla, or chimpanzee, is also produced by disease of the brain. Schaaffhausen, seemingly, would have no hesitation in repudiating the idea that the frontal specialties of the fossil are the result of individual pathological deformity. In case it should be suggested that this remarkable cranium has received its form from artificial pressure, I may observe that no one who has described it seems to entertain such an opinion; indeed its symmetry, also noticed by Schaaffhausen, "is quite opposed to the supposition that the skull has undergone any process of artificial modification."

At the conclusion of his review of all the parts, Professor King gives his own opinion: "I have now, as it appears to me, satisfactorily shown that not only in its general but equally so in its particular characters

has the fossil under consideration the closest affinity to the apes. . . . Moreover, there are considerations of another kind which powerfully tend to induce the belief that a wider gap than a mere generic one separates the human species from the Neanderthal fossil.

“The distinctive faculties of man are visibly expressed in his elevated cranial dome—a feature which, though much debased in certain savage races, essentially characterises the human species. But, considering that the Neanderthal skull is eminently simial, both in its general and particular characters, I feel myself constrained to believe that the thoughts and desires which once dwelt within it never soared beyond those of the brute. The Andamaner, it is indisputable, possesses but the dimmest conceptions of the existence of the Creator of the universe; his ideas on this subject, and on his own moral obligations, place him very little above animals of marked sagacity; nevertheless, viewed in connexion with the strictly human conformation of his cranium, they are such as to specifically identify him with *homo sapiens*. Psychical endowments of a lower grade than those characterising the Andamaner cannot be conceived to exist: they stand next to brute benightedness.

“Applying the above argument to the Neanderthal skull, and considering that it presents only an approximate resemblance to the cranium of man, that it more closely conforms to the brain-case of the chimpanzee, and, moreover, assuming, as we must, that the simial faculties are unimprovable—incapable of moral and theositic conceptions—there seems no reason to believe otherwise than that similar darkness characterised the being to which the fossil belonged.”

The learned professor imagines that he has found

the transitional link between *Homo* and *Gorilla*. But had his examination been of much value, and warranted by the anatomical features of the skull, it is not likely that Professor Huxley would have discarded such a witness to the theory of the simial origin of man as the Neanderthal fossil would thus have supplied. He has, however, another theory. "The marked resemblances," he says, "between the ancient skulls and their modern Australian analogues, however, have a profound interest when it is recollected that the stone axe is as much the weapon and the implement of the modern as of the ancient savage; that the former turns the bones of the kangaroo and of the emu to the same account as the latter did the bones of the deer and the urus; that the Australian heaps up the shells of devoured shell-fish in mounds, which represent the refuse-heaps, or kjökken-möddings, of Denmark; and, finally, that, on the other side of Torres Straits, a race akin to the Australians are among the few people who now build their houses on pile-works, like those of the ancient Swiss lakes. Finally, the comparatively large cranial capacity of the Neanderthal skull, overlaid though it may be by pithecoïd bony walls, and the completely human proportions of the accompanying limb-bones, together with the very fair development of the Engis skull, clearly indicate that the first traces of the primordial stock whence man has proceeded need no longer be sought, by those who entertain any form of the doctrine of progressive development, in the newest tertiaries, but that they may be looked for in an epoch more distant from the age of the *Elephas primigenius* than that is from us."

I had recently an opportunity of comparing a cast

of the Neanderthal skull with several modern British skulls. The comparison was suggestive enough, when made in the knowledge of these laboured discussions touching the affinities of this fossil. One of the recent British crania, especially, presented features in which the so-called abnormal characters are as fully developed as in that from the Neanderthal. It has the projecting supraorbital bones, the retreating forehead, and the flattened vertex, so characteristic of that now noticed.

As regards the age of the bed in which it was found, equal uncertainty prevails. The cavern has not only an opening below, but above also; so that, if we may credit the statement that fragments of a complete skeleton were found, its presence there is easily enough accounted for in a variety of ways. It may have been thrust in at the top by the hand of violence; it may represent some one who had taken refuge in the fissure to escape from an enemy; or the bones may have been washed in by the winter rains.

Only one other important cave may be noticed as directly connected with the cave-men. I refer to that at Aurignac, south of France. A full account of the discovery was written by M. Lartet, a considerable time after it was made. In 1852 a labourer followed a rabbit to its burrow on a steep hill-side. Thrusting his arm into the hole, he laid hold of one of the long bones of a human skeleton. His curiosity being excited, he dug away the talus, and discovered a cave, whose mouth was closed by a large slab of rock. Having removed the door, he found seventeen human skeletons, which had been buried apparently in a sitting posture. Astonished to hear of the occurrence of so many human

relics in so lonely a place, the people of Aurignac flocked to the spot, and the mayor ordered the bones to be removed and reinterred in the parish cemetery. Lartet explored this burial-place, and found, outside of the vault, a layer of ashes and charcoal, containing many human implements of stone and bone, and also the broken and gnawed bones of both extinct and living animals. Without doubt the ashes mark the occurrence of burial feasts, so common among the early Europeans. The bones of herbivorous animals outside the vault were the most numerous; and the bones and coprolites of hyænas being mingled abundantly with them led to the inference, that the hyænas used the herbivorous animals for food, devouring them at this favourite place of resort. Seventeen species of mammals were found outside, and only three within the vault,—the cave-bear, the lion, and the pig. Among those without were the remains of the elephant, rhinoceros, horse, Irish stag, reindeer, aurochs, wild cat, hyæna, brown bear, badger, wolf, and fox,—chiefly extinct animals. The remains within were less injured than those without; but they all lay in the earth beneath the human relics. The position and form of the cave, when a section was made, showed that the cave proper had been closed by an upright slab. The rabbit burrow was at the side of this. In the direction of the slope of the hill a talus of material similar to the surface of the neighbourhood was discovered, and underneath this were the bones of the animals.

Now two suppositions may be made to account for these appearances, either of which is fatal to the claims that have been urged on behalf of the immense antiquity of these cave-men. The fissure may have

been used as a dwelling-place by those whose remains were found in it. Its position rendered it liable to have the opening covered by a slip of the surface soil lying higher up. Such slips, we know, occur frequently in similar localities. The inhabitants might thus in one night be entombed in their cave-dwelling. Or, the cave may have originally been inhabited by the carnivorous animals whose bones have been found, by whom the prey may have been dragged into it; then, at a period long subsequent, the inhabitants of the district may have cleared out the rubbish and used the cavern for purposes of sepulture, near which they may have cooked their rude feasts or formed personal ornaments from the bones of the animals lying outside. I attach very little value to M. Lartet's account for yet another reason. None of the bones of the cave-men were preserved. When M. Lartet visited the district, several years after the first discovery, the place where the bones had been reinterred could not be identified. It will be seen that the facts referred to by M. Lartet admit of an explanation which wholly destroys their weight as witnesses to the antiquity of man.

The last branch of this subject relates to the age of certain superficial gravels, in which many flint implements have been found at various depths. I have found much uncertainty and confusion of thought among non-scientific, but highly intelligent, men on this point. Advantage has been readily taken of this, to press one-sided views on the attention of those who take a lively interest in questions which can be presented in theological relations, or which have Biblical aspects associated with them.

Taking the usual classification of the upper tertiary

strata, the pliocene may be broken up into the coralline crag, the red crag, and the mammaliferous or Norwich crag. Overlying these, or, rather, newer than these, the pleistocene beds occur. These, looked at generally, may be classified as beds of sand, cave deposits in part, boulder-clays, glacial drifts, and some gravels. More recent still, we have the post-glacial beds, as shell marls under peat, cave deposits in part, and valley gravels; while nearest our time, and reaching into it, are the pre-historic superficial beds, consisting of lake and river silts, peat moss, cave deposits in part, and river gravels. It will thus be seen that gravels occur in the pleistocene, post-glacial, and pre-historic divisions. Hence one difficulty in determining the age of gravels. Mr. Prestwich, the highest living authority on the question, holds that the gravels of the Somme valley, to which reference is most frequently made in this controversy, are post-glacial in their origin. This mode of characterising them is to be preferred to that which names them as post-pliocene, because that term covers so many divisions.

Flint implements have also been found in the valley of the Thames, the Ouse, etc., but I confine my remarks here to the phenomena of the valley of the Somme. This river "empties into the English Channel, after passing in a north-west direction through Picardy. Abbeville is about twelve miles from the sea, and Amiens is twenty-five miles farther up the valley. St. Acheul is three or four miles below Amiens. The valley is excavated out of chalk, and between Abbeville and Amiens averages about a mile in width, the average depth of the chalk being from two to three hundred feet. The bottom of the valley,

from its debouchure to a point far above Amiens, is occupied by beds of peat; and were thirty feet thickness of this vegetable deposit now removed, the sea would flow up, filling the valley for miles above Abbeville. The twenty or thirty feet of peat at Abbeville are underlaid by gravel, probably the same as that upon the sides of the valley bordering the peat, containing elephants' bones and flint tools, and overlaid by loam, thus forming a terrace. Above this terrace is a second, upon both sides of the valley, similarly constructed, and holding the same kinds of fossils. The sum of the thickness of the two beds of gravel is from fifty to seventy feet. The remains found at St. Acheul are also in a terrace, whose top is one hundred feet above the Somme, and a hundred and fifty feet above the sea." The higher terraces and banks of gravel are believed to be the most ancient. In the peat, works of art of the (so called) stone and iron periods have been found, and also the remains of a few animals yet living. Three human skeletons have been discovered in it. However long the period may have been which the deposit of the peat represents, it is no doubt recent.

Many flint implements have been discovered both in the higher, or older, and the lower gravels. These implements are of different forms, and bear witness to different degrees of skill on the part of their makers. Some of them are very rude, being little more than fragments of flint scarcely chipped into a definite form. Others indicate much skill, and have been used as knives, arrow-heads, and spear-heads, bearing a strong resemblance to those still to be met with among certain tribes of red Indians. These have been formed by chipping, and not, as is the case with Australian stone

weapons, by grinding. In the gravel pits at Abbeville the flint tools have been found associated with the bones of the rhinoceros, the elephant, reindeer, hyæna, and other mammals, and with land, fresh-water, and marine shells. Fresh-water shells alone occur in the high level parts. Since 1842 it is calculated that more than a thousand flint implements have been taken from the gravels of the Somme valley.

When their discovery began to have much attention directed to it, a keen controversy was urged as to whether the flints were natural or artificial. It seems hard to believe, that any one could look at some of the higher class of weapons, and entertain the least doubt on this matter. When men of science became anxious to possess specimens, a good deal of suspicion was aroused in regard to the whole subject. It was found that the demand created the supply, as if the tools of the primeval tenants of the valley had come under a well-known commercial law. There can be no doubt that, to meet the demand, the workmen in the neighbourhood began to fabricate flint implements. A friend told me that, accompanied by a workman, he began to search for flints. The spade had not been used long, when the point of a flint spear-head was exposed, and he enjoyed the gratification of picking it from the gravel with his own hand. To see is to believe. Alas for his joy in a great treasure! Looking at it narrowly with his glass, he was interested in noticing in the yellowish clay on its surface certain minute *striæ* of a peculiar kind; but, to his extreme disappointment, it began to dawn on him that the markings had been made by folds of the skin of the workman's fingers, as he had passed them over it to

smooth away the yellow clay in which it had been coated, before being deposited in the gravel a few days previously ! But though there has been much imposition associated with these discoveries, there has been no want of undeniable facts. The imitation implies the existence of the reality.

The ground already surveyed, and the remarks made on the growth of peat, and on certain features of the *loess* and of estuary deposits, have anticipated much that might have been said upon the phenomena of the Somme valley, in regard to the bearing of these on the theory of the immense antiquity of the human race. Taking, then, the depths of the valley as given above, are we warranted to conclude that the Somme once ran at the level of the higher gravels, and that it has cut a path for itself to its present depths ? I believe that other and more powerful agencies than the erosive power of running water, have been at work in that part of France. Yet this question might be answered in the affirmative, and its value as favourable to Sir Charles Lyell's views of the antiquity of man destroyed by an appeal to facts, for whose truth he is himself the voucher. In the last edition of the "Principles of Geology," when referring to the erosive action of running water, he says,—“The gradual erosion of deep chasms through some of the hardest rocks by the constant passage of running water, charged with foreign matter, is another phenomena of which striking examples may be adduced. But I shall at present confine myself to examples derived from events which have happened since the time of history. At the western base of Etna a current of lava, descending from near the summit of the great

volcano, has flowed to the distance of five or six miles, and then reached the alluvial plain of the Simeto, the largest of the Sicilian rivers, which skirts the base of Etna, and falls into the sea a few miles south of Catania. The lava entered the river about three miles above the town of Aderno, and not only occupied its channel for some distance, but crossing to the opposite side of the valley, accumulated there in a rocky mass. Gemmellaro gives the year 1603 as the date of the eruption. . . . In the course, therefore, of about two centuries, the Simeto has eroded a passage from fifty to several hundred feet wide, and in some parts from forty to fifty feet deep. The portion of lava cut through is in no part porous or scoriaceous, but consists of a homogeneous mass of hard blue rock, somewhat inferior in weight to ordinary basalt, and containing crystals of olivine and glassy felspar. The general declivity of this part of the bed of the Simeto is not considerable. . . . The external forms of the hard blue lava are as massive as any of the most ancient trap rocks of Scotland." From this point of view, then, the question comes to be a very simple one. If the Simeto has, in two hundred years, cut a ravine through hard volcanic rock, a hundred feet wide and fifty deep, how long would the Somme take to excavate its present valley in the soft chalk rocks over which it runs? In the latter case we have not hundreds but thousands of years at our disposal. It is, however, most likely that the explanation of the formation of the Somme valley is to be found in connexion with other natural forces.

In a paper read before the British Association, at Newcastle, Professor Phillips pointed to the forces now referred to. He said, "As there is reason to suppose

that the valley had been subject to upheaval, we should not be able to determine the question of age by the mere excavation of the river. If we follow the suggestion of Sir Charles Lyell, and take our measure from Scandinavia, we might come to some determination as to time; but this was the case of a local disturbance of the earth's crust, affecting certain lines of country in a given direction, and apparently ceasing beyond that." The remark has turned out far more important than Professor Phillips could have anticipated. Let us apply it to the question now under review. There is, on the one hand, a recognition of the action of disturbing forces within the area, held to supply very strong proof of the great antiquity of man. On the other hand, inquirers are put on their guard against Sir Charles Lyell's favourite basis of calculation for almost all changes of level of the surface; that, namely, which is the rate of upward movement in Scandinavia at present. It is worth while to look a little more narrowly at these. When regarded from certain points of view, they really help to lead us into rest on this subject. Moreover, the importance of this will be appreciated by all who are alive to the vital issues, which hang on a right settlement of this great scientific and scriptural question.

If it be true, that, within a comparatively recent period, oscillations and ruptures of the earth's surface have taken place, in the localities where the superficial deposits are found which have supplied materials for the controversy, the phenomena are involved in yet further uncertainties. Yet this is now the case. The foremost observers find unmistakable evidence of such surface oscillations. In an able paper "On the Distribution of

the Flint Drifts of the South-east of England, etc.," by Sir Roderick Murchison, there are some very important remarks on this subject. "To my mind," he says, "the circumstances of the same drift being placed at such different levels at Folkestone, and of its sloping up from the sea-board to a height of 222 feet inland, are good evidences that these creatures were destroyed by violent oscillations of the land, and were swept by currents of water from their feeding-grounds into the hollows in which we now find them, and where the argillaceous materials which covered them have favoured their conservation. Nothing can more strongly favour this view than the manner in which fragments of chalk-flints, often angular, are wedged together in the matrix of loam, and enter into the cavities of some of the vertebræ and broken bones of the large quadrupeds. . . . No analogy of tidal or fluvial action can explain either the condition or position of the debris and unrolled flints and bones. On the contrary, by referring their distribution to those great oscillations and ruptures by which the earth's surface has been so powerfully affected in former times, we may well imagine how the large area under consideration was suddenly broken up and submerged. This hypothesis seems to me to be an appeal to a *vera causa* commensurate with the results. As respects the south-east of England, the operations must have been modern in a geological sense; for our present line of sea-coast had then been formed, our lands, including great longitudinal valleys in the Weald, were tenanted by herds of great quadrupeds: whilst, even anterior to the catastrophe by which such land animals were destroyed, sea-beaches of rolled pebbles, containing species of molluscs still living, had previously been

accumulated on our southern shores, together with some remains of extinct quadrupeds which had been derived from the adjacent lands! In short, the cliffs of Brighton afford distinct proofs, that a period of perfect quiescence and ordinary shore action, very modern in geological parlance, but very ancient as respects history, was followed by oscillations and violent fractures of the crust, producing the tumultuous accumulations to which attention has been drawn."

Both Sir Charles Lyell and Mr. Prestwich frequently fall back on the action of similar forces, to explain certain appearances in the physical geology of the districts in which flint implements have been discovered. Thus, the expressions "certain oscillations in the general level of the country," "the old river (Ouse), aided perhaps by the continued upheaval of the whole country, or by oscillations in its level, went on widening and deepening the valley, often shifting its channel." "A valley or river channel was cut through them (Mundesley fresh-water formations), probably during the gradual upheaval of the country." Many such sentences might be quoted. But if the operation of the disturbing elements be thus clearly marked, we have only to bring the period of their action farther down than has hitherto been done, in order to see that they also must cease to be held true witness to an immense antiquity for the human race. It has been shown, that the large extinct animals were most likely contemporaneous with man, at a time not more remote than may be brought within the period of Biblical history (pp. 225-233). And if it cannot be positively proved, that the oscillations now referred to could not have taken place about the time when these animals became

extinct, or soon after, we are certainly not entitled to build on the phenomena which resulted therefrom, any hypothesis opposed to common belief as to the very recent appearance of man.

In a most interesting paper read before the Royal Society, March 27, 1862, by Mr. Prestwich, much which is most striking in the present appearance of the gravels of the Somme is traced to the action of ice. The paper is entitled, "Theoretical Considerations on the Conditions under which the Drift Deposits containing the Remains of Extinct Mammalia and Flint Implements have accumulated; and on their Geological Age." Referring to the flint implements, the author says:—"These works of men are first discovered in beds of the high-level gravel period. The most ordinary shapes are the large spear-head form, either with a sharp point or a flat rounded one, and with the butt end sometimes blunt, and at other times chipped to an edge. With regard to the manner in which they came to be imbedded in the gravel, it can only be surmised from their condition, from our present experience, and by considering the uses to which they could possibly have been applied." These conditions are then reviewed, and it is shown that the flint implements rarely or never show indications of atmospheric weathering; that they are rarely worn, but are usually sharp and angular, like some of the large unworn flints which have been attributed to transport by ice; also that they are most common where the evidence of ice-action is the greatest, as at St. Acheul and Moulin Quignon. The climate of the period having been severe, it is essential to keep in mind the usages of tribes under like conditions at the present day. The mode of life of the Chippeweyan Indians and

the Esquimaux is then considered ; and it is shown that a hatchet, an ice-chisel, a file and knives, of stone or metal, are all the instruments they need or use. It is further shown that when in winter the usually abundant supplies of reindeer fail, these people resort commonly to fishing in the frozen rivers, and then use their chisels for making holes in the ice. These implements are also in daily use for keeping open the water-holes. Analogous facts are quoted from Wrangel respecting Siberia. The author suggests, therefore, that some of the mysterious flint implements of St. Acheul may have been used as ice-chisels. Reasons are then assigned for their presence chiefly at particular spots, and reference is made to other forms of flint implements. "The melting of the winter snow would necessarily cause spring-floods. Another cause of floods is the fall of rain whilst the ground is still frozen. These causes, combined possibly with a larger rainfall, must have afforded to the old rivers, either permanently or, at all events, during spring-time, a volume of water far exceeding any present supply, and given them more of a torrential character." Instances are quoted from Sir R. Murchison's "Russia" and Wrangel's "Siberia," and others, to show how this is still the case every spring in northern countries, causing a rise in the rivers of from ten to forty feet, and inundating the adjacent valleys.

Other forces, however, besides an increase in the water-power, seem required to account for the excavation of the great valleys ; and the author thinks that cold and ground-ice have performed a very important part in the operation. In support of this view, he adduces the opinion of Arago and the observations of M. Leclercq and Colonel Jackson, both

of whom show how constantly this ice is formed in cold climates in rivers with stony and gravelly bottoms, such as the old post-pleiocene rivers must have been. Amongst other observations given are those of M. Weitz, who states that in the north of Siberia the formation of ground-ice can be seen in the rivers at a depth of fourteen feet and more, and that in "rising from the bottom the masses of ice bring up with them sand and stones, and let them down at places far distant from whence they came;" and he concludes "that not only does the current occasion a change in the bed of the river by its erosion of the looser soil, which it carries from one place to deposit in another, but that the ice, which forms at the bottom of rapid rivers in very cold countries, tends also to effect a change in the beds of those rivers." Another agent would co-operate with the last; this is the freezing of the ground and the rending of rocks by frost. Taking extreme cases, Crantz shows to how great an extent this operates in Greenland; Dr. Sutherland gives some still more striking instances on the shores of Barrow Strait, and Sir J. Richardson on the Mackenzie River. Even in our own country, the disintegration produced during one severe winter on a fresh vertical section of chalk is very striking. A remarkable instance is quoted from Sir R. Murchison's "Russia," of a long terrace of angular blocks of limestone broken up and left by the winter-ice thirty feet above the summer level of the Dwina, near Archangel.

The reader has thus before him an outline of the state of the question, and of the theories proposed to account for the phenomena of the Somme Valley. It will be seen, that the point of interest again turns on

attempts to determine the time at which certain great climatal changes and disturbances must have taken place, and the period over which their action extended. If, as I have shown, we may bring their action much nearer true historical time than has generally been imagined, the question of its intensity or force does not present many difficulties. Alluding to geologists who rank "all ancient geological phenomena in the category of existing causation," Sir R. Murchison says:—"The endeavour to refer all former fractures of the strata as well as their overthrow on a great scale, as in the Alps, to causes of no greater intensity of action than those which now prevail, is in opposition to the observations I have made in every mountain-chain, as well as in the modest cliffs of Brighton and Dover." The uniformitarian theory, so strongly condemned here, is that which Sir Charles Lyell has applied throughout his discussions on this question. He has assigned to Norway "a mean rate of continuous vertical elevation of two and a half feet in a century," and assumed this as the standard rate of elevation in most other quarters. But if anything is sure in physical geology the variable intensity of these agencies is. Indeed, this theory of uniform action is contradicted at every point. Many circumstances, for example, influence the rate at which mud is deposited in lakes, in river courses, and in estuaries. The growth of peat depends much on climatal conditions, which vary in different degrees of latitude. Then what so capricious and so variable in its intensity as the force which makes itself known in the rocking earthquake, or as that which finds expression in the volcanic eruption? Even the introduction and disappearance of zoological species, of which so

much has recently been made, not only refuse to give that testimony in favour of uniformitarian views, so anxiously sought from them, but bear witness to facts of an entirely different kind. When, then, we sum up the strongest points in favour of an antiquity for man far more remote than is assigned to him in the word of God, I think the conclusion is warranted, if not irresistible, that they signally fail to cast distrust on the Biblical historical record.

In making this statement, I have fully in view not only Sir Charles Lyell's work, but the papers of M. Morlot, "On the Study of High Antiquity," and other works on both sides of the question. M. Morlot works from the uniformitarian point of view, and arrives at any results which an imagination, evidently rather strong, had before fixed. Here is a specimen of M. Morlot's modest inductions:—"We have recorded some observations on the cone or torrential delta of the Tinière as furnishing an estimate, in number of years, of the date of a given moment of the bronze age, of a given moment of the stone age, and of the time which the whole delta took to form—that is, the length of the modern geological period. These observations, as we have seen, have furnished—for a given moment of the bronze age, and marking to all appearance its end, an antiquity of from twenty-nine centuries at least to forty-two centuries at most, the real date being about thirty-eight centuries; for a given moment of the stone age, probably also marking its end, an antiquity of from forty-seven centuries at least to seventy centuries at most, the real date not being far from sixty-four centuries; and for the age of the whole delta from seventy-four

centuries at least to one hundred and ten centuries at most, the real date being probably about one hundred centuries. . . . What has been said goes to establish a duration of about one thousand centuries at least for the last geological epoch, which began immediately after the retreat of the last great glaciers, which was characterised by the presence of the *Elephas primigenius* and by the appearance of man, and which ended at the beginning of the modern period, the latter having already lasted about one hundred centuries. . . . Let us hope that these computations will be soon tested by comparison, and, no doubt, be also more or less corrected and improved by other observations." When Sir Charles Lyell looked at some of the phenomena with which M. Morlot deals here, he saw that his theory, if applied to them, would furnish astounding results, but shrank from the task himself. "Some one," he said, "must have the chivalry to begin." He has found his knight!

But nothing is so well fitted to mark the danger of the principles, whose application makes such demands on imagination, than to have them carried out by sanguine theorists like M. Morlot. The fruits of such guesses put even young observers on their guard. Thus they are welcome. One cannot help returning with thankfulness and satisfaction to truer and safer ground. Nothing has yet been done to shake our confidence in that ground. Just as the literature of Greece and Rome has shed much light on the latest Biblical history, and the stone records of Egypt, Babylon, and Assyria, have let in unlooked-for light on its earlier and middle periods; so all the lines of zoological and geological science are seen, as the multitude of

busy workers make known well-authenticated facts, to converge to the one point, even to the corroboration of the scriptural account of creation, and of the comparatively recent appearance of man on the earth.



CHAPTER XIII.

THE UNITY AND BROTHERHOOD OF THE HUMAN RACE.

Quotation from Sir William Hamilton—Man's twofold nature—Eccles. iii. 18-20—Christ's kingdom and man's—Views of modern materialists on man's nature—Instinct and reason—Human brotherhood—Interactions between science and Scripture—Man's place unique—Views of systematists and ethnologists—Two schools—Place of the negro—Missionary effort—Christ "Lord of All."

"WHAT man holds of matter," says Sir William Hamilton, "does not make up his personality. Man is not an organism, he is an intelligence served by organs; they are his—not he." This view strikes the point at which Scripture and true science bear one testimony as to man's place in nature. In one aspect of his nature, man is linked with the lower animals; in another he has mental qualities which make a great gulf between him and the beasts put under him—a gulf which can never be bridged over. Regarding him from the one point of view, there are features which at once claim for him a place in that zoological scale, which reaches from the humblest protozoan up to man. Looking at him from the other, he is seen to be linked to God himself, and characterised by peculiarities of mental and moral constitution, so many, so vital, so broadly marked as differing from the mere animal nature, that, without doing violence to science, you cannot find a place for him in any scheme of systematic zoology. His bodily structure, the composition of his blood, the build of his

bones, the leading phases of his embryonic condition and development, his organic growth, and the phenomena of bodily decay and death, all demand that he should be associated even with those irrational, irresponsible animals, whose spirit "goeth downward to the earth." It was this discovery which for a time clouded the mind, and wrung the affections of David's wise son: "I said in mine heart concerning the estate of the sons of men, that God might manifest them, and that they might see that they themselves are beasts. For that which befalleth the sons of men befalleth beasts; even one thing befalleth them: as the one dieth, so dieth the other; yea, they have all one breath; so that a man hath no pre-eminence above a beast: for all is vanity. All go unto one place; all are of the dust, and all turn to dust again" (Eccles. iii. 18-20). Solomon had before him the ruin which sin had wrought on man. It had blinded him as to his true destiny, and to the power of the spiritual nature to triumph over the purely animal nature. In this condition, thus sunken, ignorant, and sensual, what better was he than the beasts? On all these points he required to be enlightened—he required a revelation. Thus, the desire of the king, that "God might manifest them." When, however, we take into account man's rational nature, his will, his affections, his imagination, his hopes, his capacity of education, and the countless states and frames of the true "living soul," we meet with elements which refuse to fit into any scheme of zoological classification that attempts to deal with man as if his place were not unique in nature. When God sets the consciousness of all this before us by Divine manifestation, how great the change! We look within and around

us. We become united to him, as holding the consciousness of a higher destiny than belongs to the lower animals.

“This dull chrysalis
Cracks into shining wings, and hope, ere death,
Spreads more and more and more.”

“I die,” said one who had made great nations quake before him, “I die before my time; and my body will be given back to the earth, to become the food of worms. Such is the fate which so soon awaits the great Napoleon!” Then, remembering a system in direct contrast with that one which he had toiled to establish—a system in which God has manifested to man not only what human nature is, but the cure, relief, remedy, for all its ailings, ills, and deep degradation—he exclaimed, “What an abyss between my deep wretchedness and Christ’s eternal kingdom, proclaimed, loved, adored, and spreading through the world!”

The materialists of the present day seek to escape from the influence of this view of man by alleging, that brute instinct is not different from human mind. Both, they say, are of the same nature. They differ only in intensity, in degree of strength, in adaptive power of will and of concentrative purpose. Narrowed to this point, the issue may be accepted by thoughtful Christian men. Leaving discussions on abstract points, they can appeal to facts. Take, for example, the capacity of education. If the so-called mind of the lower animals be generically the same as the mind of man, why not manifest the identity by its fruits? Why not take one of the forms which, in mere animal structure, approaches nearest

to man, and educate it? The absence of the divine, distinguishing gift of speech should not be a hindrance. The soul may be reached, and it may find unmistakable modes of manifestation in the absence of this. There are a thousand other points which might be urged. I would, however, be content to peril the whole question on this one.

The recent introduction, by certain naturalists, of grossly materialistic views into the natural history of man, could not but have a most distracting influence in the present condition of the public mind. The widespread intelligence which has resulted from increased means of popular elementary education, from the recent growth of cheap literature, and from the immense power which the cheap newspaper has put within the reach of the people, is at once ready to lay hold of, and to use for purposes most in harmony with prevailing tastes, the utterances of men of science on this and kindred topics. That the effects of the materialistic views, now referred to, have not been more influential and mischievous, is mainly to be traced to the fact, that now, more than at any other period in the history of our land, the truth of Christ has brought under its power the thought of the nation. The Church has entered more deeply, than for centuries she had done, into the mind of her living and exalted Head. She has learned, as at his feet, the lesson of his life. His heart was set on his Father's glory. His meat was to do the will of his Father. He came to seek the lost, to save them. Thus must it be with his Church. She has caught a glimpse of her calling; and in seeking to follow it has not been unblest. But notwithstanding all this, the influence of the unscientific conclusions, loudly ex-

pressed by a small band of workers in the sphere of natural science, has to some extent been successful in diverting men's attention from what ought to be the highest aims of life :

“Howe'er it be, it seems to me
'Tis only noble to be good.”

The direction in which this disturbing influence tends is to separate man from man. It is a fact, which finds its illustration in all history, that the lower the views are which prevail regarding man's nature and destiny, the deeper his selfishness becomes. If you separate between the interests and the higher hopes of a people, you come in time to destroy the hopes altogether, and to concentrate the affections, the energies, the endeavours on material interests alone. It is no doubt true, that the Divine thought which, as an element of health, is met with in the family compact—the domestic constitution—angel-like, keeps the social state in some measure sound, even when its presence is not recognised ; but the power of this is sadly weakened by everything which tends to draw away man's mind from that twofold association, his dependence on God, on the one hand, and his bond of brotherhood uniting him to his fellow-men, on the other.

Now here we meet with several most interesting aspects of interaction between science and the word of God. Science, we have seen, separates man from the mere animal, and demands an independent and unique place for him in virtue of his spiritual nature—reason, will, the power of introspection, self-consciousness. This place is in the very presence of his Maker, as one destined originally for childlike commu-

nion with Him as a father. The word of God ratifies this discovery, and shows that, in virtue of the nature which science recognises, whether it will or no, man is bound to discharge the duties of a child towards God, and those of a brother towards his fellow-men. Hence the provision for love; hence the call to action. Taking, then, the views of the word of God and of the highest workers in science, let me indicate their scope from this standing point. I look at the scientific side of this truth first.

The earliest systematic effort at true scientific classification is met with in the works of Aristotle (Paris edition, vol. i. 1619). He excluded man from his scheme, and thus regarded him as unique, and not to be classed among animals proper. Aristotle accepted the views of those whom he called "the older naturalists," and ethnologically classed man according to manners and appearance. Thus, character was to be known according as a man was found like to those nations who differ in this way (ὅσα διέφερε τὰς ὁψεις καὶ τὰ ἦθη), as Egyptians, Thracians, and Scythians. The British naturalists, Ray and Willoughby, adopted Aristotle's view as to man's non-animality proper. Linnæus associated the genus *Homo* with *Simia*, or Ape, lying below in the same scale, and united both under the order *Primates*, or the highest group of true animals. Cuvier followed in the same track, but felt the necessity of making the separation more distinct and wide. This led him to deny that the anterior limbs of the ape are true hands, a characteristic which belongs only to those of man: hence his orders *Bimana*, or two-handed, and *Quadrumana*, or four-handed; a name implying that the four limbs are more or less prehensile organs, but not as the human

hands are. Still a want was felt. Some characterisation was looked for which would acknowledge psychological features, even if it should not directly and distinctly embrace them. Lamarck, himself the most accurate of observers, but the most wayward and fanciful of systematists, had acknowledged the want and made an effort to supply it. Thus his sub-group *Intelligents*, or thinking animals. But, as with so many other happy suggestions, he turned the ridicule of scientific workers on this by ranking fishes, reptiles, birds, and mammals equally among the intelligent animals! He had got hold of a truth, but he hastened to destroy its power by setting it in false lights. In one sense it is undoubtedly true, that gradation in complexity of structure is accompanied by gradation of mental faculty, but it is not true that structural peculiarities determine the measure of what he called intelligence—a term which embraced all the instincts of the lower vertebrates, as well as the reason, imagination, and will of man.

Professor Owen, no doubt under the same feeling of the defective character of every scheme which did not give a place to the distinguishing features of man, has assigned to him a division by himself, under the title *Archencephala*, a term which has the merit of singling out the organ through which mind acts. I think, too much has been made, by some who object to this, of the fact that he has designated a lower sub-class, in which he includes the quadrumana, or monkeys, by the name *Gyrencephala*, or animals with convoluted brains. Some of these, as the marmosets, have smooth brains, and thus do not fall under this term; while man, who is distinguished by a deep convoluted brain, is excluded from it. Nevertheless the characterisation is a valuable

one, were it on no other ground than as the evidence of an effort on the part of our great comparative anatomist to meet the want—to fill in the blank space. The whole tendency of the, so-called, advanced school of working naturalists, with Professor Huxley at their head, is, as we have already seen, to take us back to the Linnæan point of view, and to restore the name *Primates*, as including both man and monkeys.

Side by side with these systematists, the ground is occupied by ethnologists whose leanings to one party or the other are well marked. Not, indeed, as if they took either view as a starting point, but rather because their systems seem the complement of the one or the other. The two great ethnologists of the eighteenth century, Camper and Blumenbach, worked as earnestly from the point of view of belief in the unity of the human race as have their accomplished successors in the nineteenth—Pritchard and Latham. But Gliddon, Knott, Morton, Agassiz, and some others, have worked as earnestly and with great, though varying ability, from an entirely opposite and antagonistic point of view. They believe that man has sprung from various original stocks, differing very widely in rank of mind and even moral features. It was to be expected that these observers would assign a foremost place to the families to which they themselves belong. They might, however, have done this without attempting to un-soul others farther removed from the early centres of civilisation, and, especially, less in contact with that light from Heaven which, even from the beginning, has shed its influence over the favoured families of mankind.

The scientific discussion of the unity and brotherhood of the human race raises many questions of great

interest at the present time. These have reference to anatomical structure, geographical distribution, the earliest traces of a primeval race, language, and specific difference of appearance. The chief anatomical difficulties have been fully reviewed in chapters x. and xi., and those associated with archæology have also been examined in the chapter on the Antiquity of Man. Throughout these chapters the positions stated in this one have been constantly in view. The other questions now named claim some notice, before special reference is made to the scriptural statements on this subject.

* We have been asked "if it is at all likely that the men who have left traces of their presence over wide geographical areas, in superficial gravels, in caves, in cromlechs, in rude urns, and on ruder sculptured stones, could have belonged to the Adamic race, whose history is not older than six thousand years?" The families to whose existence all these point, are alleged to have had firm footing in districts far remote from the original seat of the Adamic race, long before the dawn of traditional history. Underlying this question is the impression, that, if it could be shown there must have been an older race than that sprung of Adam, the objections to the theory of a plurality of stocks, to account for the present varieties of mankind, would be much weakened, if not done away with altogether. So much has been said in the preceding chapter, with the view of showing how little weight is to be attached to this aspect of the question, that we need do no more than refer to it again.

If we turn to the only authentic written record we possess of the earliest migrations of the human race, we

cannot fail to observe how very soon mankind wandered far from the quarter where the sons of Noah first dwelt after the subsidence of the Deluge. (Gen. x.) Some found their way to regions far east of Euphrates and Tigris; others wandered into Southern Asia, and spread along the shores of the Persian Gulf. Some sent out colonies to territories north of the Caucasus; others struck off westward and began to people the shores of the Mediterranean and Central Europe. Some followed the eastern shores of the Red Sea, and no doubt crossed into Africa at the straits on the south, and others took possession of Egypt, and sent offshoots into Libya and along the southern shores of the Mediterranean.

When Moses narrated these early migrations he lived in the centre of a teeming and highly civilised population. But the increase in the numbers of men, and the highly advanced condition of the arts, say, in a country like Egypt, present no difficulties as to the unity of man and his comparatively recent origin. Whatever progress had been made in art, in the times before the Flood, would, no doubt, be preserved in the family of Noah. And with such facts before us as the peopling of America in three generations, and Australia in one, what need have we to fall back on the hypothesis of a plurality of races to account for the presence of man in remote districts at the dawn of the historical period? I have elsewhere remarked, that "while the general branches spread over certain well-marked geographical tracts, colonies were frequently thrown off. Only in this way can we account for the intermingling of traces of each of the great divisions of language in the dialects of particular districts. A good illustration occurs in the case of the Phœnicians. Herodotus (i. 1)

says of them 'that they had migrated from the shores of the Red Sea to the Mediterranean, and settled in the country which they now inhabit.' And, when describing the arrangements of Xerxes, he relates (vii. 89) that 'the Phœnicians, with the Syrians of Palestine, furnished three hundred, being thus equipped: on their heads they had helmets, made very nearly after the Grecian fashion; and clothed in linen breastplates, they carried shields without rims, and javelins. These Phœnicians, as they themselves say, anciently dwelt on the Red Sea; and having crossed over from thence, they settled on the sea-coast of Syria; this part of Syria, and the whole as far as Egypt, is called Palestine.' 'By the Erythræan Sea,' says Mr. G. Rawlinson, 'Herodotus intends, not our Red Sea, which he calls the Arabian Gulf, but the Indian Ocean, or rather both the Indian Ocean and the Persian Gulf, which latter he does not consider distinct from the ocean, being ignorant of its shape.' Did the Phœnicians send a colony from Phœnicia Proper to the shores of the Persian Gulf, or was part of Syria colonised by emigrants from the shores of the Indian Ocean? Even to this day a very close resemblance can be traced between names common to both regions."

In the cumulative argument in favour of the unity of the human race, the question of language holds a prominent place. The statement of Scripture on one aspect of the subject is very plain and distinct: "The whole earth was of one language, and of one speech" (Gen. xi. 1). But many ask, "Is it possible that the innumerable branches of language now in the earth can be traced to one original stock? Is it likely that one race could give rise to all these?" In the answer to

these there is much room for intricate philological discussion and illustration, but as this would lead us away from the main purpose of this volume, we shall do no more than appeal to two or three authorities on this important subject. "Languages compared together and considered as objects of the natural history of the mind, and when separated into families according to the analogies existing in their internal structure, have become a rich source of historical knowledge; and this is probably one of the most brilliant results of modern study in the last sixty or seventy years. From the very fact of their being products of the intellectual force of mankind, they lead us, by means of the elements of their organism, into an obscure distance, unreached by traditionary records. The comparative study of languages shows us that races now separated by vast tracts of land are allied together, and have migrated from one common primitive seat; it indicates the course and direction of all migrations, and, in tracing the leading epochs of development, recognises, by means of the more or less changed structure of the language, in the permanence of certain forms, or in the more or less advanced destruction of the formative system, *which* race has retained most nearly the language common to all who had emigrated from the general seat of origin" (*Humboldt*). The rapidity with which a common type of language assumes very many different forms has been described by one of our greatest philologists:—"If we observe how Latin was changed into Italian, Spanish, Portuguese, Provençal, French, etc.—how Latin, again, together with Greek, and the Celtic, the Teutonic, and the Slavonic languages, together likewise with the ancient dialects of India and Persia, must

have sprung from an earlier language, the mother of the whole Indo-European or Aryan family of speech—if we see how Hebrew, Arabic, and Syriac, with several minor dialects, are but different impressions of one and the same common type, and must all have flowed from the same source, the original language of the Semetic race—and if we add to these two at least one more well established family of speech, the Turanian, comprising the dialects of the nomad races scattered over Central and Northern Asia—if we watch this stream of language rolling on through centuries in these three mighty arms which, before they disappear from our sight in the far distance, clearly show a convergence towards one common source—it would seem, indeed, as if there were an historical life inherent in language, and as if both the will of man and the power of time could tell, if not on its substance, at least on its form.

. . . . The historical changes of language may be more or less rapid, but they take place in all times and in all countries. They have reduced the rich and powerful idiom of the poets of the Veda to the meagre and impure jargon of the modern Sepoy. They have transformed the language of the Zend-Avesta, and of the mountain records of Behistun, into that of Ferdusi and the modern Persians; the language of Virgil into that of Dante; the language of Uphilas into that of Charlemagne; the language of Charlemagne into that of Goethe" (*Max Müller*). "Our historic researches," says the late Chevalier Bunsen, "respecting languages have led us to facts which seem to oblige us to assume the common historical origin into which we found the nations of Asia and Europe to coalesce. The four families of Turanians and Iranians, Khamites and

Shemites, reduced themselves to two, and these again possessed such mutual material affinities, as can neither be explained as accidental or as being so by a natural external necessity, and therefore imply a common descent." "Looking back," says Dr. Hincks, "to all the most ancient languages, I find that although there were marked differences which rendered them utterly unintelligible to one another, there were points in common which, when fairly examined, proved that those languages had all a common origin. The people separated—were divided; some parts of the ancient language survived in one portion, some in another, and so on. None of the languages retained even any large part of the original, but each, probably, sufficient to identify it as part of one original language." Many more quotations might be made. Let these suffice. The very highest authorities in the science of language unite with the writers of Scripture in bearing testimony to the original unity of language and the unity of man.

It has been held that the doctrine of the unity of the race is contradicted by the well marked difference in the physical features, and, in many cases, mental characteristics, of different families. This has raised the vital question, "What constitutes species?" I have already pointed out that the origin of species is definitely stated in the first chapter of Genesis. Now it is worth noting that the weight of scientific authority falls in with the Biblical view, even though, in stating the natural history aspect of the subject, science had no reference to the word of God. Specific forms are such as have descended from common parents; in man's case from a single pair. This

definition admits of great variation in appearance, and of considerable modifications even in structure. If the circumstances and surrounding influences associated with the first offspring had continued with all the successive generations, the likelihood is, that the physical features would have continued the same. But geographical distribution, climatal peculiarities, and the like, would everywhere bring forces into play which tended to modifications in structure, and to great variety of appearance. So soon, however, as the original conditions were realised, the forms would hasten to revert to the normal type. This is equally true when we take man's influence over the lower animals into account. Whenever domesticated animals return to a wild state, reversion to original type begins, and in the course of a few generations is complete. The domestic boar, widely unlike the wild boar of the Pyrenees, was introduced by Spanish colonists into St. Domingo, and some of them with the females having been neglected and permitted to run wild, in a short time a breed appeared closely resembling, in make and colour, the wild varieties of Spain.

Looking at the different families of man, in the light of all the information which ethnology can furnish, we are warranted in asserting, (1) That the variation in the human species is not greater than that met with among the lower animals, whose descent from a single pair is not questioned; and (2) That individuals occur differing as widely in appearance from the family to which they belong, as does this family from another, for which ethnologists, opposed to the doctrine of the unity of man, demand an independent standing as a separate race. For example, taking the horse, the dog, the rabbit,

and the pigeon, what a difference there is between the London dray-horse and the Highland pony; between the bulldog and the greyhound; the common wild rabbit of England and the large and pendulous-eared black and white variety, the favourite of breeders; or between the wild rock-pigeon and the pouter, the ruff, the fantail, or the carrier pigeon. If we look at oxen and sheep the same facts meet us. Again, individuals of fair countenance and bright red hair have been met with among the Papuans, and albinos are not uncommon in Central Africa. In nature many instances might be given, both from among beasts and birds, which have come under our own notice.

If the human race, as it comes under the influence of well marked, varying conditions, as to food and climate, manifests a constant tendency to assume features which constitute distinctive varieties, this is no more than what we meet with among the animals put under man. In horses great variety occurs. Those of Iceland and some parts of the north of Europe are, for the most part, dun, with a black stripe along the spine; those of Corsica have a constant tendency to become beautifully spotted; and in the north-west part of India the Kattywar breed is generally striped along the spine, the legs barred, and the shoulder stripe often double. The Roman poets loved to celebrate the river Clitumnus for its herds of snow-white oxen. "The ox of the Roman Campagna is universally grey, while, in some other parts of Italy, the breed is mostly red." In this country we can point out, in a herd of cattle, those that have been brought from the west Highlands, from the south of Scotland, from Ireland, or from Holland. The sheep and the dog show equally well marked varia-

tions, both as regards form and colour. So with birds. And even fishes, insects, and molluscs fall easily under the same influences. How suggestive, for example, the blindness of the cave-fish, the cave-crustacea, and the cave-insects of America. "In some of the crabs the foot-stalk for the eye remains, though the eye is gone; the stand for the telescope is there, though the telescope with its glasses has been lost." In some of the cave-animals, as the rat, the organs of sight are very large, as if, in the effort to preserve the seeing eye, the organs had grown in size. A far longer list of instances might be given illustrative of the power of *habitat*, climate, and the like, to produce even a wide range of variation, both in colour and structure.

If, then, we look at the great families of mankind from this purely zoological point of view, do we meet with anything different, as regards external appearance, from the phenomena now referred to? Is there greater unlikeness between the head of the negro, the aboriginal Australian, the European, and the Hindoo, than there is between the head of the greyhound and that of the mastiff or the bulldog? Is the difference of colour greater in these widely separated varieties than what is seen among men? Does the hair of the negro differ more from that of the most favoured families, than the wool of the British sheep from that of the sheep of Guinea? "Here," says an old traveller, writing of Guinea, "the world seems inverted, for the sheep are hairy, and the men woolly." Does the fact that the Jew of Malabar is pure black, lead ethnologists to disregard family features of a constant kind, and deny to him a place among the descendants of

Abraham? In virtue of some of these more constant characteristics, the Arab of Nubia is associated with the Arab of Yemen. Yet the former is absolutely black, the latter is almost as fair as some of the Scandinavian tribes. "The contrast," says Dr. Latham, "to the Anamese must be sought in the Mincopie of the Andaman Islands. These are called blacks, without qualification, by the few observers who have described them. Nay, more, they have been ignored as members of the class under notice (Mongol), and been placed amongst the Papuans of New Guinea. Yet their language shows them to belong to the same division with the Burmese of the opposite continent." A review of mental and moral features would also show us that individuals, or even important sections, of the great divisions under which ethnology has classified the human race, differ from the family or division to which they belong as widely as the division itself does from the others. Again, then, both as regards physical and psychical features, we find nothing, when they are fairly estimated, opposed to the doctrine of the unity of mankind.

The Biblical references to this subject present many features of great interest. "And God said, Let us make man in our image, after our likeness." "So God created man in his own image, in the image of God created he him; male and female created he them" (Gen. i. 26, 27). When the Creator made woman, "and brought her unto the man," Adam said, "This is now bone of my bones, and flesh of my flesh: she shall be called Woman (*isha*), because she was taken out of Man" (*ish*). The words are suggestive of interests and sympathies in connexion, perhaps, with the mar-

riage tie, closer and deeper than those indicated in the terms Adam (*formed from the ground*) and Eve (*mother of all living*). It was to this act of the creation of a single pair, as the common parents of the whole human race, that our Lord referred when he said, "He which made them at the beginning made them male and female" (Matt. xix. 4). Such passages must ever be held to protest against all theories as to a plurality of original stocks in order to account for the leading varieties of mankind. They point to that relationship, in descent from a common stock, which everywhere implies the privileges and responsibilities of brotherhood. "God that made the world and all things therein . . . hath made of one blood all nations of men for to dwell on all the face of the earth, and hath determined the times before appointed, and the bounds of their habitation; that they should seek the Lord" (Acts xvii. 24-31). Men, the apostle shows, are of one blood. There is only one Saviour, Jesus, of whom he preached. But all men are equal as to the Gospel offer, and therefore God "commandeth all men everywhere to repent." The time is pressing, the cause urgent, the motive one of the most powerful that could be presented to rational beings, "Because he hath appointed a day, in which he will judge the world in righteousness." We see then how closely these aspects of truth hang together.

But there are some who refuse to look at the Biblical aspects of this subject, and it is both curious and instructive to note the phase unbelief is here assuming.

Take, for example, the attitude of many to the negro, as one of a race held to have sprung from a stock different and inferior to that of the white

man. He is first, on grounds which would not have been held sufficient in determining the place of beast or bird, set down as specifically distinct, and then quietly set aside as radically defective in mental gift and moral sense, and beyond the hope of improvement. It is true, that many appeals have been made to illustrations of as high intellectual capacity and enlightened Christian principle in members of this family, as have been met with in the so-called higher races; but all this is in vain. None are so blind as those who refuse to see. The only admission which men of this stamp will make is, that there are elements of mind and heart about the negro of a very inferior kind, and that he may be left to any religious system which will harmonise with these. But on no account must you attempt to Christianise, for you will only spoil what good there is about this hopelessly sunken species of man. He is naturally honest now, but your Christian teaching will make him a thief; naturally faithful, as a dog to its master, your instruction will make him false, obstinate, headstrong, and rebellious; he is naturally trustful, you will render him suspicious; and as a climax, he is naturally religious, but your attempts to Christianise him will only end in begetting in him a hardened scepticism, the degradation of the only quality about him which had gained for him the compassion of the enlightened races. We are asked to "leave him to Islamism, the only religious system which in its wondrous pliability gratifies the religious longings of the subtle Asiatic equally with the degraded African, without interfering with their personal tastes and their social habits." This is the kind of talk, bordering on blasphemy, to

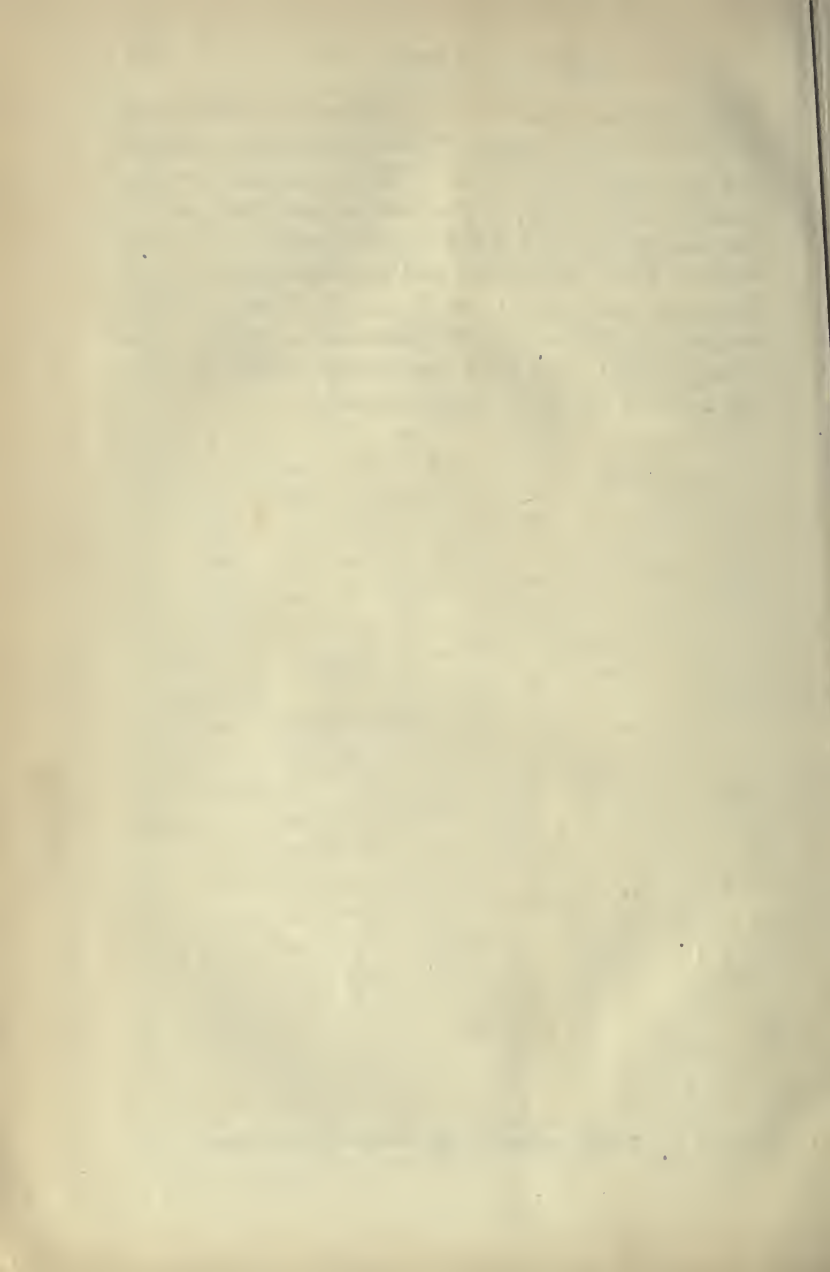
which the British people are invited to listen, from the lips of sciolists banded together as men of science. It is enough to make intelligent men turn away with disgust from anything bearing the name of science, when they see the prejudices and the tastes of scientific observers hastening them into questions beyond their province, and leading them to conclusions as unworthy of true science as they are of human nature itself. If our students of anthropology have no better contributions to the literature of their favourite pursuits than Vogt's work referred to above, and no better employment than to rail against Christian effort in behalf of a people long and sinfully neglected, the less we hear of them the better.

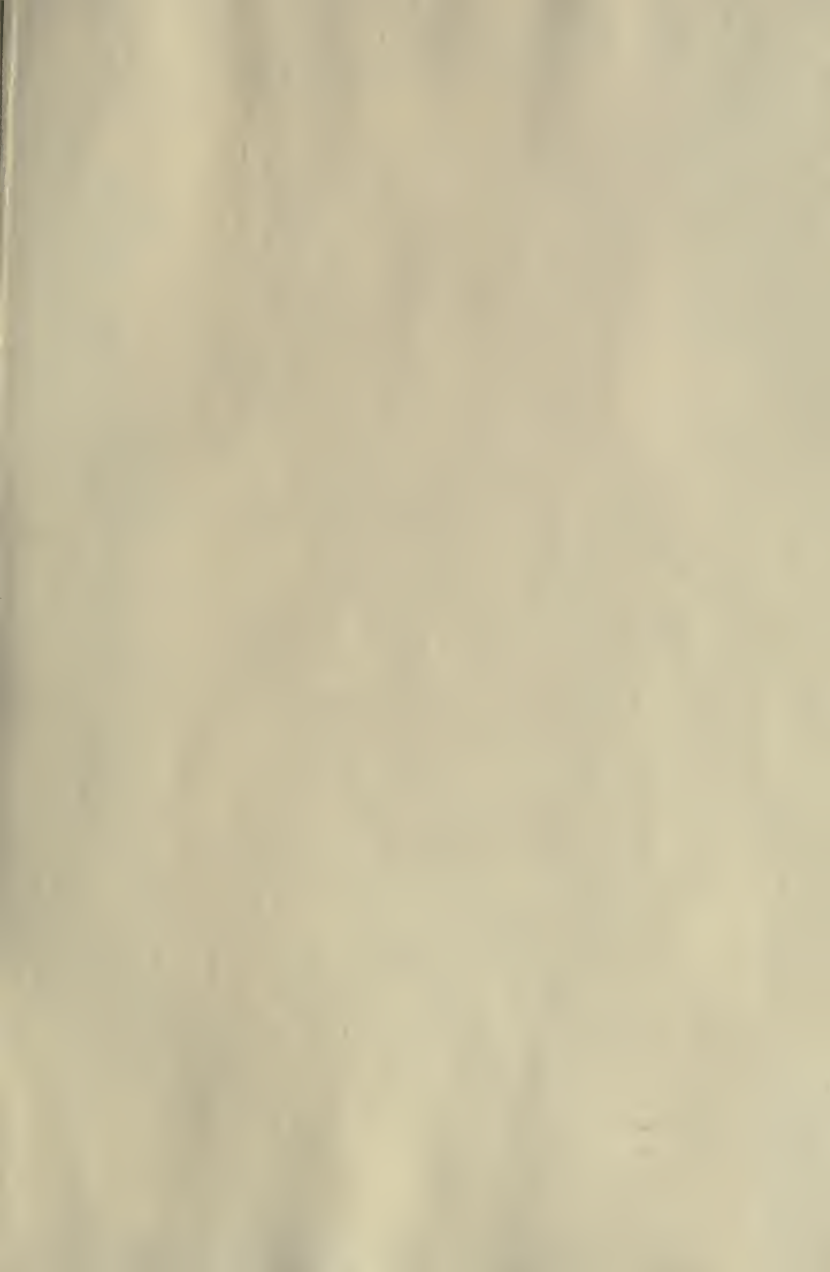
The practical direction, however, which this assumes is one which could hardly have been expected. The success of missionary efforts amongst the coloured races of the world demonstrates their essential unity with the white races. Only downright infidelity can question the remarkable blessing which has attended the work of British Christian missionaries in Africa. Yet men do question it, just as the labours of Christian missionaries in India, between thirty and forty years ago, were misrepresented and their success denied. The men who had left their homes, with their lives in their hands, to carry the tidings of the glorious grace of Christ to the Hindoo, were set down as impostors; as men who cheated a too credulous religious public; as in the habit of describing conversions which never occurred; and as being actuated by the basest and the meanest of motives. All this is now passed away in regard to India; but the same charges are brought against African workers by travellers, moreover, who

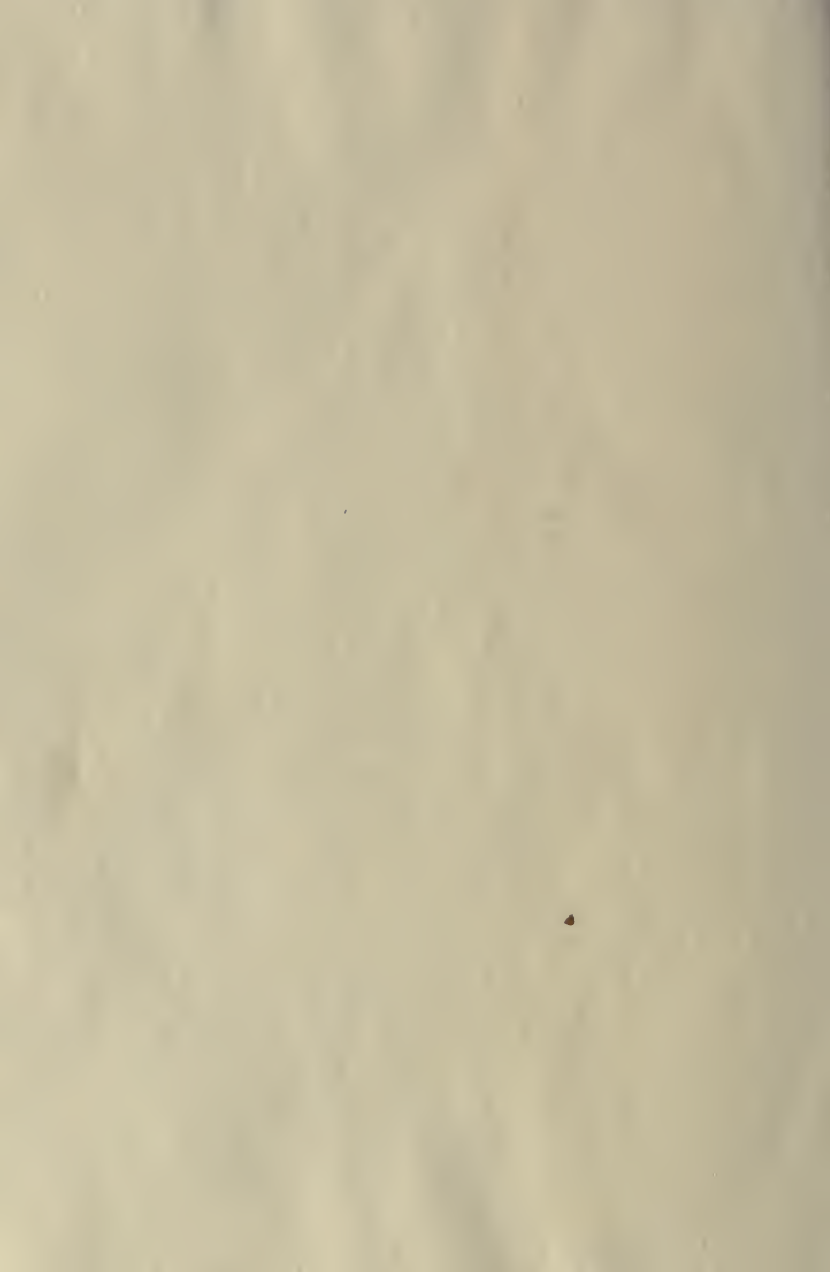
have visited the scenes of their labour. The Old Indian in those days displayed hostility to the truth preached by hostility to those who preached it. Ignorant of their motives, it denounced the men whose words and example witnessed against them. This is the explanation of the opposition still.

The immediate effects of this spirit all tend to distract Christian attention, to break in upon the thought which, from this point of view, should above all others influence man, even that of the common brotherhood of the race, and of the responsibility of those who have received the the Gospel of Christ to make it known to all the world. True science and Holy Scripture form one estimate of man. Both recognise the unity of the human race; both acknowledge one origin for man; both bear testimony to his nature as more than animal; and both own that this oneness of standing implies oneness of responsibility. "No man liveth to himself." But a fact of even deeper import and interest meets us. Christ is seen to be the head of creation, as he is "head of his body, the church"—the former by lordship as Creator; the latter by purchase, as Redeemer. By him all things were created with which the student of science deals, and to his headship in grace all Scripture testifies. If I love him as creator and redeemer, I shall seek to show forth his glory. Gazing on his eternal beauty as revealed in the word, I come to be transformed by the renewing of my mind, and thus the calling of my life is to bear witness to the power of his grace over me, and to the influence of his truth and spirit in me. If, again, I go into nature, loving the Creator not only as God, wise, kind, good, or even almighty; but as one who has become to me Friend, Kinsman, and Brother,

shall I not have pleasure in unfolding the evidences of his presence, the proofs of his wisdom and goodness and love in his own works? Will not Creation become, in all its rich beauty, its manifold adjustments, and its fine adaptations, that which, together with the inspired written Word, makes the one great revelation which God has made of himself to man? Never will the student of science find his path clearer, or his work more pleasant, than when his researches have in view the glory of Christ as "LORD OF ALL."







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